MECHANICAL ENGINEERING

October 1957

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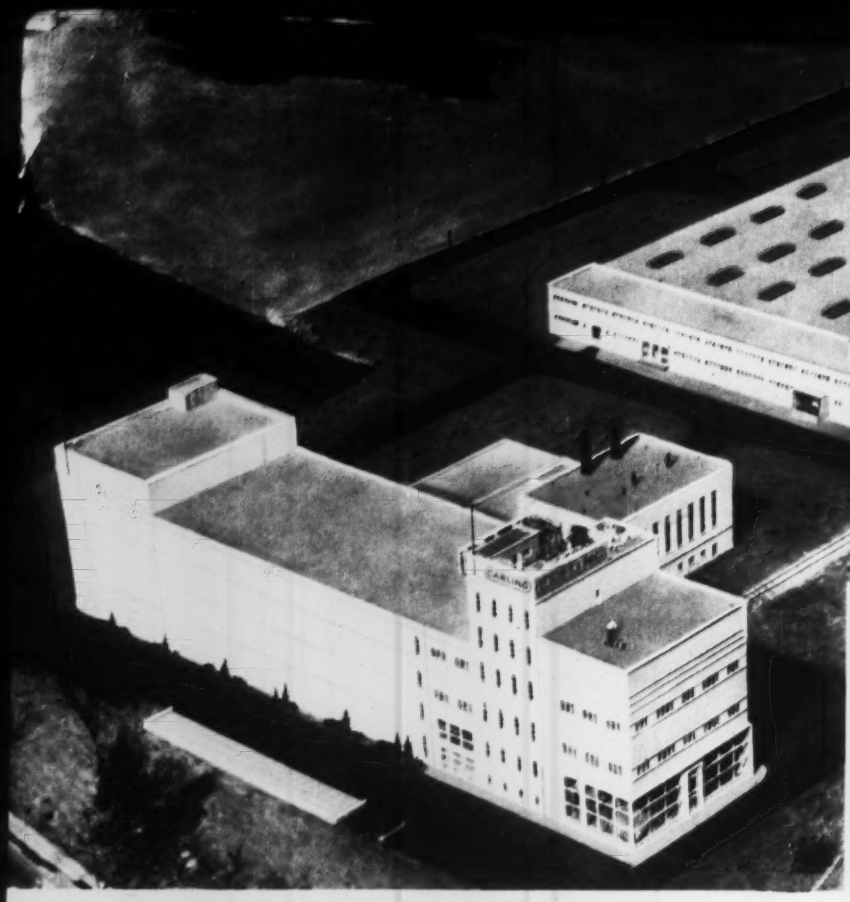

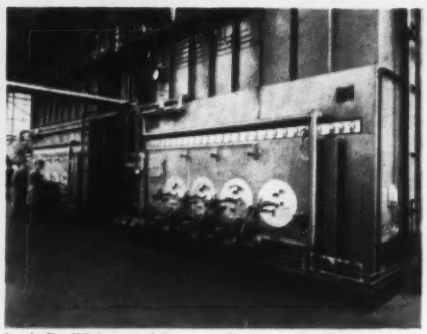

Each B&W Integral-Furnace Boiler at Carling's Natick plant has a capacity of 58,000 lb of steam per hr at operating pressure of 150 psi and 200 psi design pressure. Plant designed by: Carling Brewing Company, Engineering Department, Cleveland. Architect: John Marshall, Canadian Breweries, Ltd., Toronto. General Contractor: Gilbane Building Co., Providence, R. I.

B&W Integral-Furnace Boilers Prove Reliability at Carling's

TWO UNITS ASSURE CRITICAL TIME CYCLING IN BREWING PROCESS

Carling Brewing Company's Natick, Mass., plant, the first new brewery in New England in more than 40 years, produces 600,000 barrels of Red Cap Ale and Black Label Beer a year. Steam for the brewing process, pasteurizing, sterilizing, and heating the plant is supplied by two B&W Integral-Furnace Boilers.

One Unit Alone is meeting the plant's maximum load of 35,000 lb of steam per hr, with the second on a stand-by basis. This boiler-room schedule is part of the plant's overall design, which will permit adding another 600,000 barrels of capacity when required.

After a Year of Operation, Lewis R. Grant, Chief Engineer, reports that the oil-fired boilers have given instantaneous response to load changes and are operating at high efficiency. There has been no maintenance necessary since the boilers went on the line.

Reliability Is Important at the Natick plant because of the exacting time cycling of the brewing process. The B&W units have easily met this test. The steam delivered has been clean and dry, with no indication of solids carry-over.

B&W Integral-Furnace Boilers, for any steam requirements up to 350,000 lb per hr and for all fuel conditions, incorporate installation, operating, and maintenance features that give greater boiler efficiency, availability, continuity of service, and overall economy. They provide maximum capacity in small space, high fuel economy, smokeless combustion, and economical, fast steaming. Completely integrated units, they are backed by the undivided responsibility of a single manufacturer, with nearly a century of steam generating experience. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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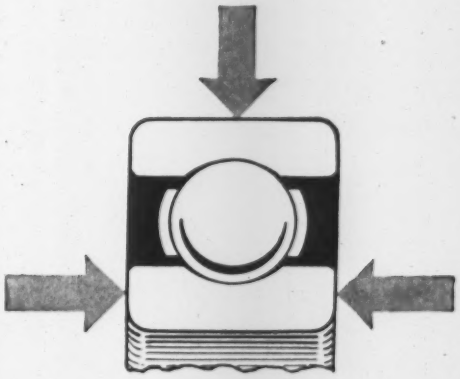
BABCOCK & WILCOX

B&W

BOILER DIVISION

ND FACTS



The Word *Versatile* Fits Like A Glove!

Fits because—this basic New Departure ball bearing, more widely used than any other antifriction type, does much more than carry RADIAL loads—it locates the shaft it supports against THRUST LOADS FROM BOTH DIRECTIONS equally well!

Fits because—with a simple snap ring added, it does away with inside housing shoulders, simplifying mounting and cutting machining costs!

Also—with efficient Sentri-Seal added, without change in exterior dimensions, it eliminates a separate outside closure—assures protection from outside dirt!

And—with Sentri-Seals on both sides, this same basic bearing does away with all separate seals, eliminates all need for lubricating fittings—requires no attention for greasing!

Finally—it is a long-lived, non-separable unit that calls for no shims or other devices for periodical adjustments.

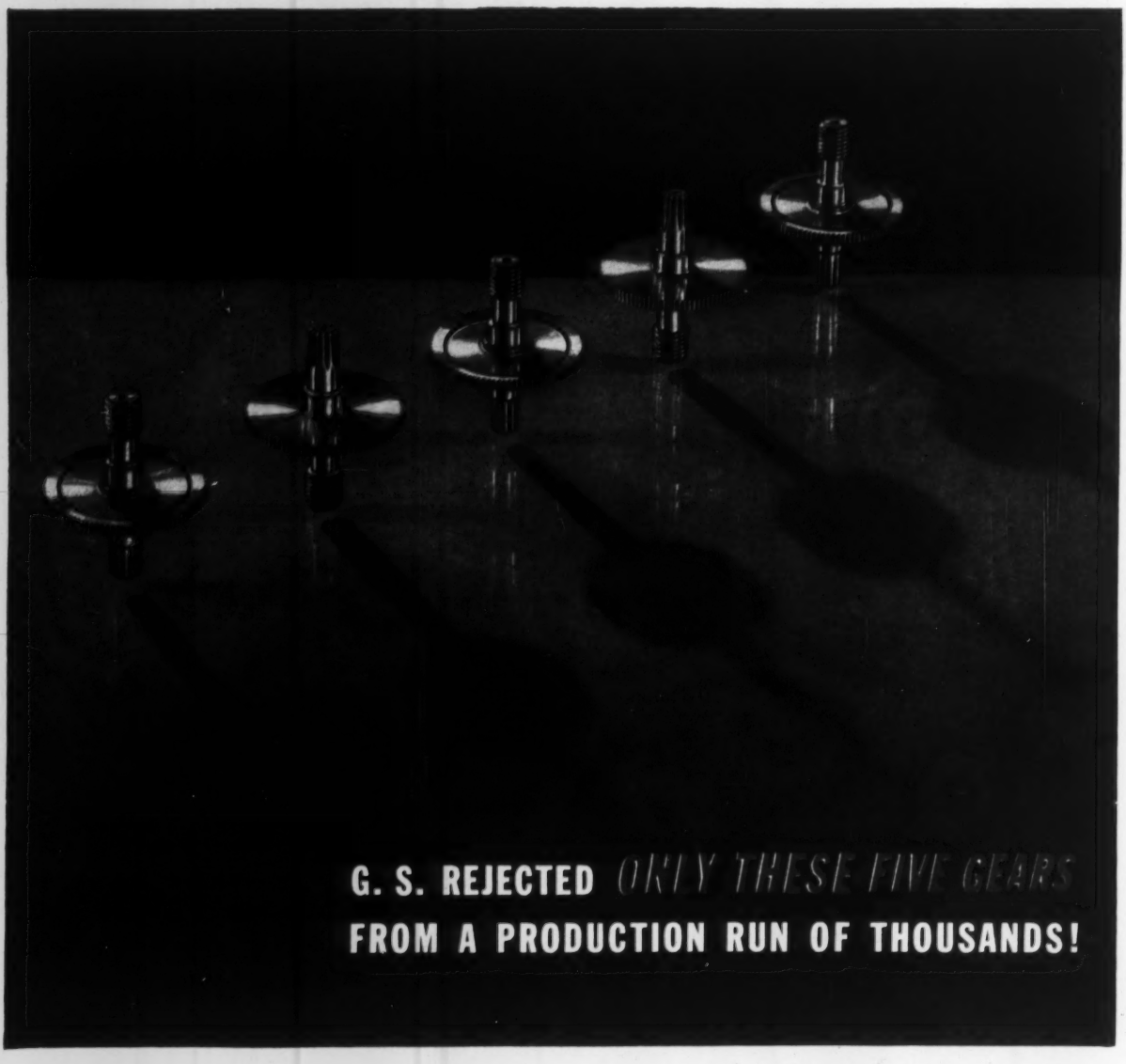
So, specify New Departures of the type that assures you maximum application proficiency and economy.

ND NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

MECHANICAL ENGINEERING, October, 1957, Vol. 79, No. 10. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations



FRACTIONAL HORSEPOWER GEARING

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WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARING

Rejects are rare in a run of G.S. Gears. When errors do occur, our skilled inspectors catch them. Because of slight imperfections, the five Gears you see above were the only ones rejected *before shipping* a production run of *thousands!*

The Gear at center of shaft has 94 teeth, 60 N.D.P., 20° P.A., held to precision tolerance after Heat Treating. Heat Treating WITHOUT WARPING of frail sections is a highly developed specialty here at G.S.

The Worm at one end is single thread, 60 N.D.P., 20° P.A. A special relieved form on the thread profile eliminates tip interference.

The Spline at the opposite end is 48 N.D.P., 14½° P.A. and has 12 teeth. It is held to maximum cumulative pitch error of .0015", a maximum involute error of .0005" and a maximum lead error of .0002". The bearing diameters are ground to .0003" tolerance.

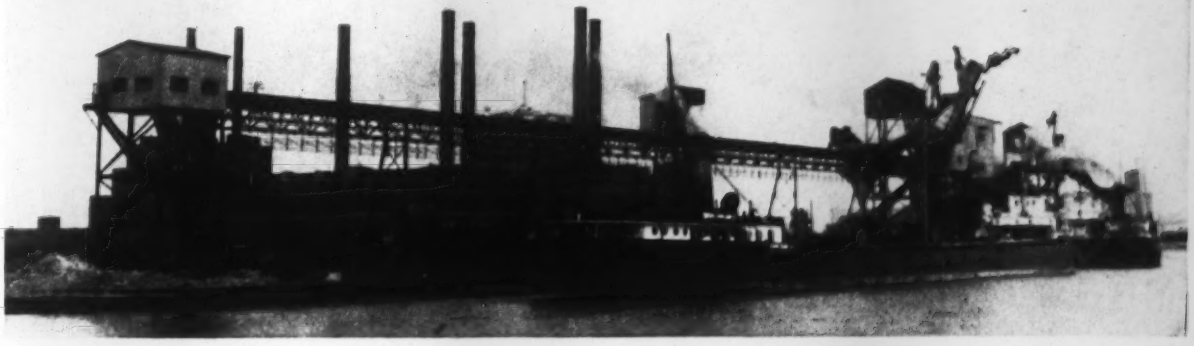
If Small Gearing of *extreme uniform accuracy* in production runs of hundreds or thousands is a consideration in YOUR business, by all means phone or write us NOW.

SEND FOR..

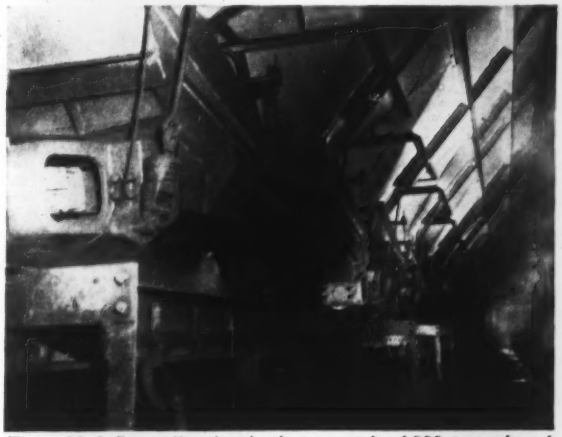
G. S. technical data, free! See where and how we mass-manufacture Small Gearing to uniformly fine tolerances. Folder contains 23 pictures of Small Gears, plant view, as well as Diametral and Circular Pitch Tables. Ask for your copy on company stationery, please!

41 Years of Specializing in Small Gearing!

Coal moves fast from railroad cars to ships at this transfer dock.



Rapid handling improves competitive position of 29 participating coal companies



These 20 Jeffrey vibrating feeders can take 4,000 tons of coal per hour from hoppers under car shake-outs. Electronic controls vary the feed to assure a uniform rate of flow to the 72-inch conveyor belt that carries the coal to boat loading telescopic chutes.

COAL is transferred quickly, economically, from railroad cars to ships here at Rail-to-Water Corporation's Chicago docks. This permits the 29 Midwestern coal companies who are partners in this enterprise to sell their coal on the Great Lakes.

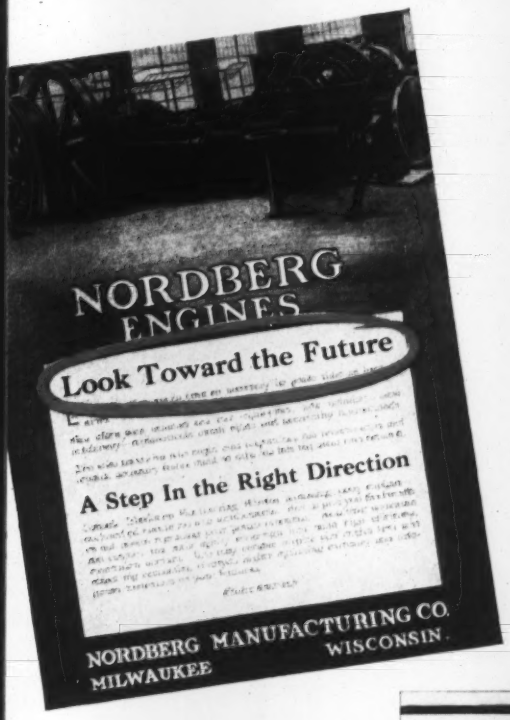
Typical equipment contributing to the speed which spells economy is this line of 20 Jeffrey electric vibrating feeders. They keep coal on the move with a minimum of attention, saving manpower. Vibrations are timed to their natural mechanical frequency, insuring minimum use of power and quiet, trouble-free operation. No wearing of parts, so maintenance costs and downtime are low.

Catalog 870 describes Jeffrey vibrating feeders. The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

Look Toward the Future



NORDBERG continues to anticipate and meet the power needs of industry

True today as it was in the early 1900's when the advertisement at the left was published, Nordberg continually looks toward the future needs of the power industry. This philosophy characterizes Nordberg . . . a leader in the progress made in internal combustion engines. With *experience* as our guide Nordberg continues to pioneer . . . to design and build highly efficient prime movers . . . prime movers that will economically and reliably provide the power required in the decades of tremendous growth ahead.

NORDBERG MFG. CO., MILWAUKEE, WISCONSIN

Builders of America's Largest Line of Heavy Duty Engines

NORDBERG

DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

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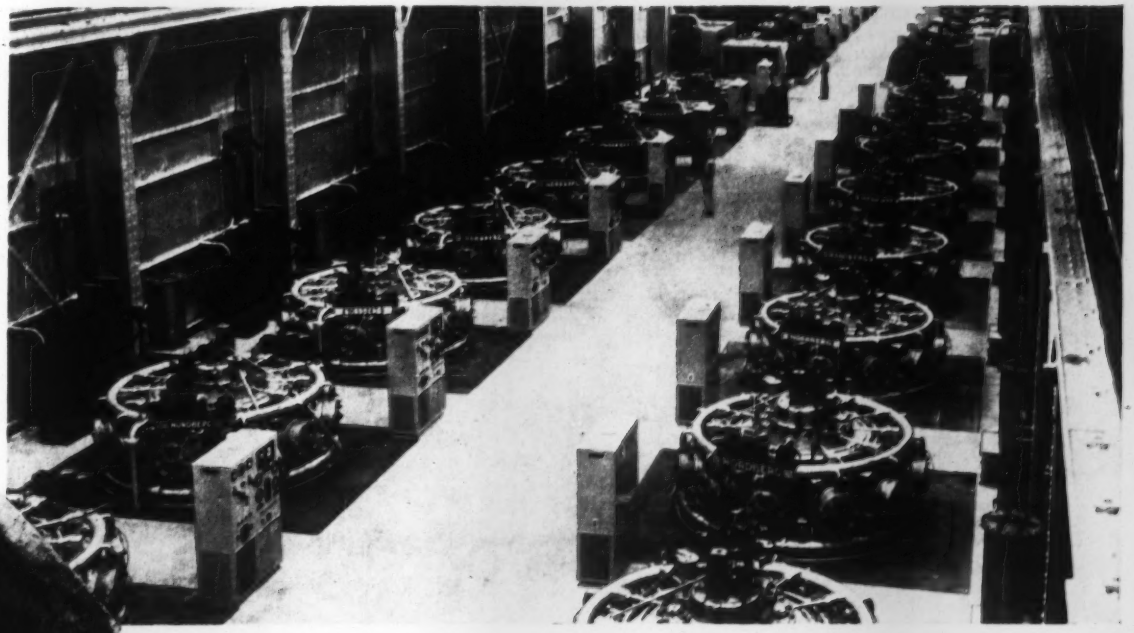
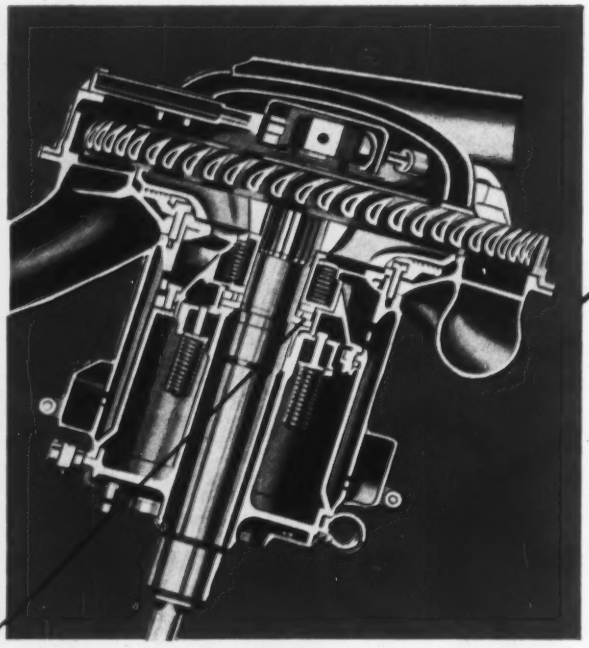


The world's largest internal combustion engine power station—220 Nordberg spark-ignition gas burning Radial engines generate all power for electrolytic reduction of aluminum at the Aluminum Company of America's Point Comfort, Texas smelting works. 22 more Radial engines soon to be installed will provide nearly 475,000 total horsepower. This installation is an excellent example of Nordberg's ability to meet specific power requirements.

GRAPHITAR® OIL SEALS play important part in dependable performance of new powerful CURTISS-WRIGHT TURBO COMPOUND ENGINES

Increased demands for faster non-stop service has placed even greater demands on the engines that power modern airliners. Helping to meet this need is the powerful EA Series Turbo Compound engines built by the Wright Aeronautical Division of the Curtiss-Wright Corporation, Wood-Ridge, New Jersey. In each of these 18-cylinder giants, 3 GRAPHITAR oil seals play an important part in maintaining the dependability, efficiency and power of this engine.



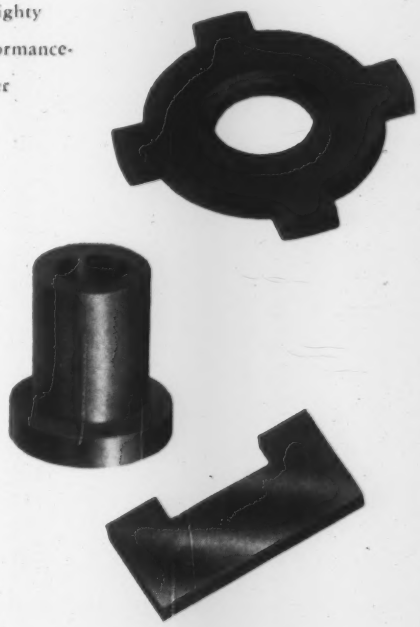
Three power recovery units are employed on the Turbo Compound to utilize normally wasted exhaust gases and provide still additional thrust. The GRAPHITAR seals are used on the turbine shaft in each of these units and must withstand continuous high speeds and high temperatures. These seals prevent hot gases from reaching the shaft bearings and carbonizing the lubricant. Low coefficient of friction, and the excellent wear and sealing properties of GRAPHITAR make it ideally suited for this demanding installation.

Over 35 of the world's leading airlines are flying DC-7's and Super Constellations on which Turbo Compounds furnish the power . . . and each air mile proves that GRAPHITAR is the logical engineering material for applications that demand the best.

THE UNITED STATES

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® SINTERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

GRAPHITAR seals, bearings and parts in everything from the mighty atomic submarine USS Nautilus to automatic toasters are performance-proving the diverse qualities of GRAPHITAR. Compacted under extreme pressure, and fused at heats to 4500° F., GRAPHITAR can be formed into relatively complex shapes, ground to tolerances as close as .0005". Since it is entirely self-lubricating, GRAPHITAR can be used where only steam or water are present. Lightweight, durable, chemically inert and virtually unaffected by extremes of vibration, pressure, or temperature . . . that is the miracle material, GRAPHITAR.



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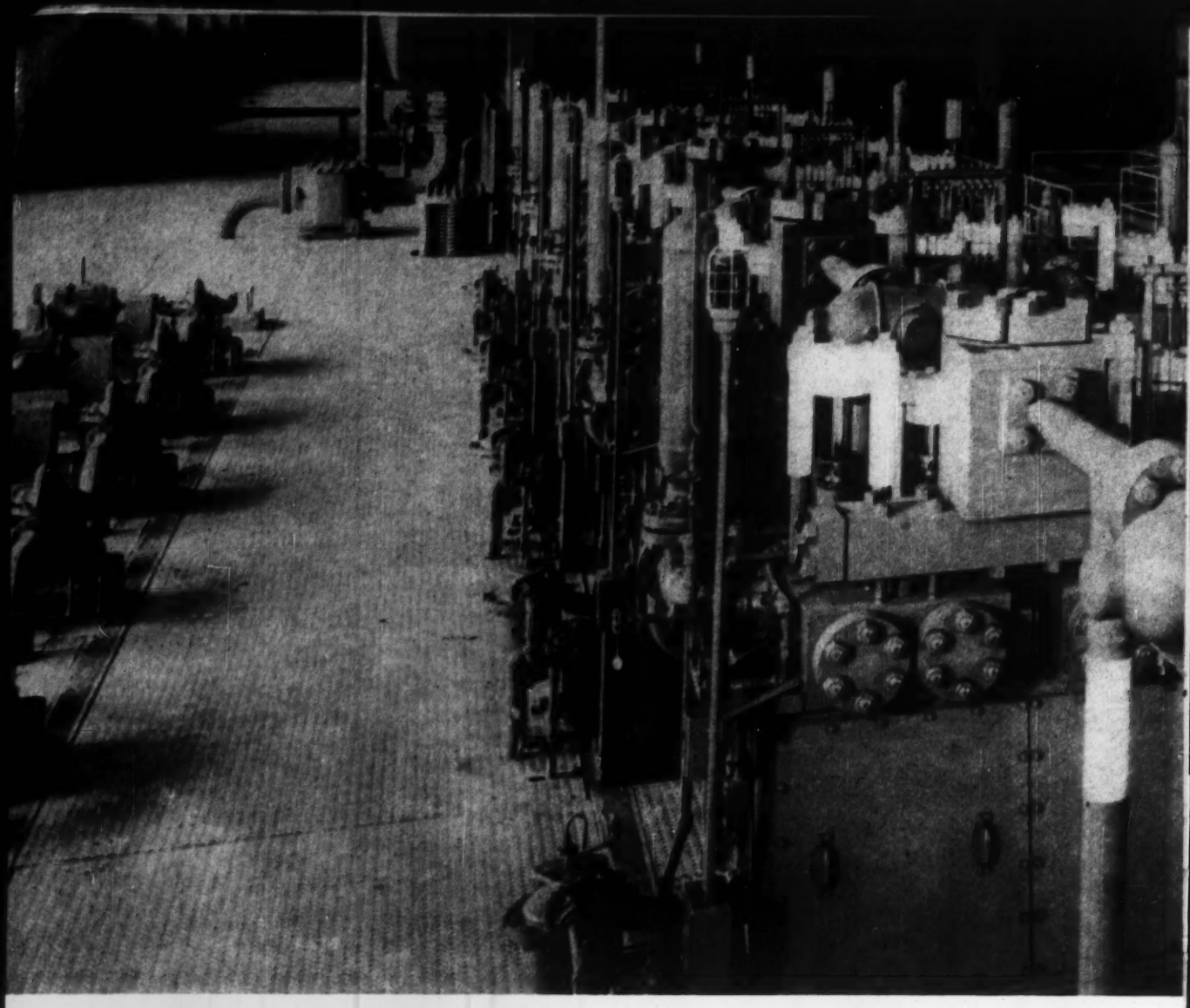
Get this fact-filled GRAPHITAR engineering Bulletin No. 20. Write today for your copy. If you have design questions on problems, our engineering staff will be happy to assist you in any way possible.

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN



HOW TO SELECT A CENTRAL

By R. K. GROBHOLZ, Power Pump Department, Worthington Corporation

Basic facts about selection and application of hydraulic accumulator systems and how you benefit by dealing with a company that can supply the complete engineered package

Mushrooming growth in the use of hydraulic equipment such as this huge forging press makes an understanding of accumulator systems a "must" for plant engineers.

With the tremendous growth in the use of hydraulic equipment for plastic and rubber molding, forging, extruding, die casting and other operations requiring high pressure, engineers are spending more and more time on the application of accumulator systems.

On the following pages, we would like to present some helpful information on accumulator selection and application.

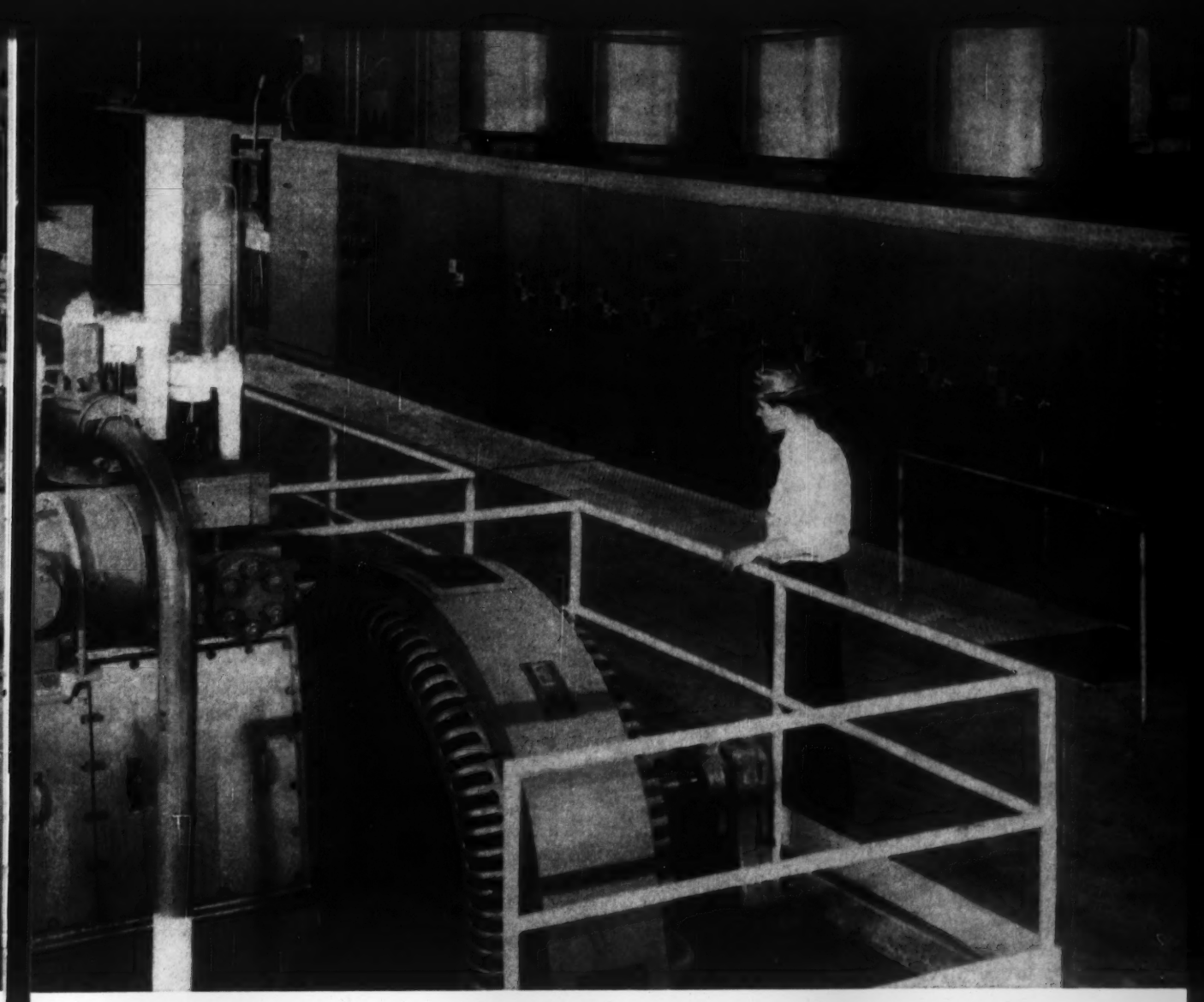
Accumulators slash equipment costs

The basic reason for using an accumulator system is economy. By using the time in between hydraulic demands to replenish the accumulator, you reduce the size of pumping equipment needed. In addition, accumulators supply variable flow to your hydraulic requirements and help "cushion" hydraulic shock.

A properly designed central accumulator system for supplying a battery of hydraulically operated machines will more than halve your operating and maintenance costs. You also release valuable production space because you can locate your "centralized" system in an out-of-the-way spot. And too, initial cost of the accumulator system may be less than individual pumps.

Three types to choose from

You have three basic types of accumulator



ACCUMULATOR SYSTEM

systems to choose from: weighted-ram, air piston, and air bottle. As shown in the chart at the right, for the smaller capacities and for pressures above 5000 psi, either the weighted ram or air piston type is usually preferred. For the great majority of applications, however, the air bottle system is more economical and requires less maintenance.

Air bottle has many advantages

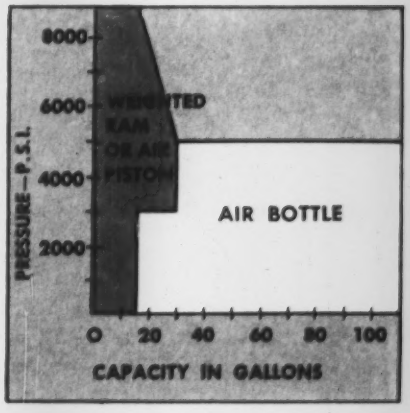
The major advantage of the air bottle system is its supreme simplicity. It has no stuffing box, no moving ram. In fact, it has no moving parts and hence needs no maintenance. It tends to absorb and minimize shocks. Working pressures are adjustable. It has a large reserve capacity. Installation is simplified—an ordinary foundation is all that's needed.

Since 80% of the accumulator systems now being installed are of the air bottle type, the rest of this article is devoted to its selection and application.

Selection is simple—but plan for expansion

The selection of the proper size equipment is very simple. Size is determined by two factors: *peak* hydraulic demand and the *average* demand. The former controls the size of the accumulator and piping; the latter the pumping equipment.

Air bottles can be used singly or in multiples, and can be operated in parallel or series, or a combination of both. The common operating pressure differential is usually about 10%, but varies slightly with requirements of the machinery being operated. Should hydraulic requirements increase, bottles can be added with relative ease if the system is properly designed.



Guide for choosing your accumulator. For the great majority of applications, the air bottle type is preferred. In borderline cases, service conditions will affect the final choice.

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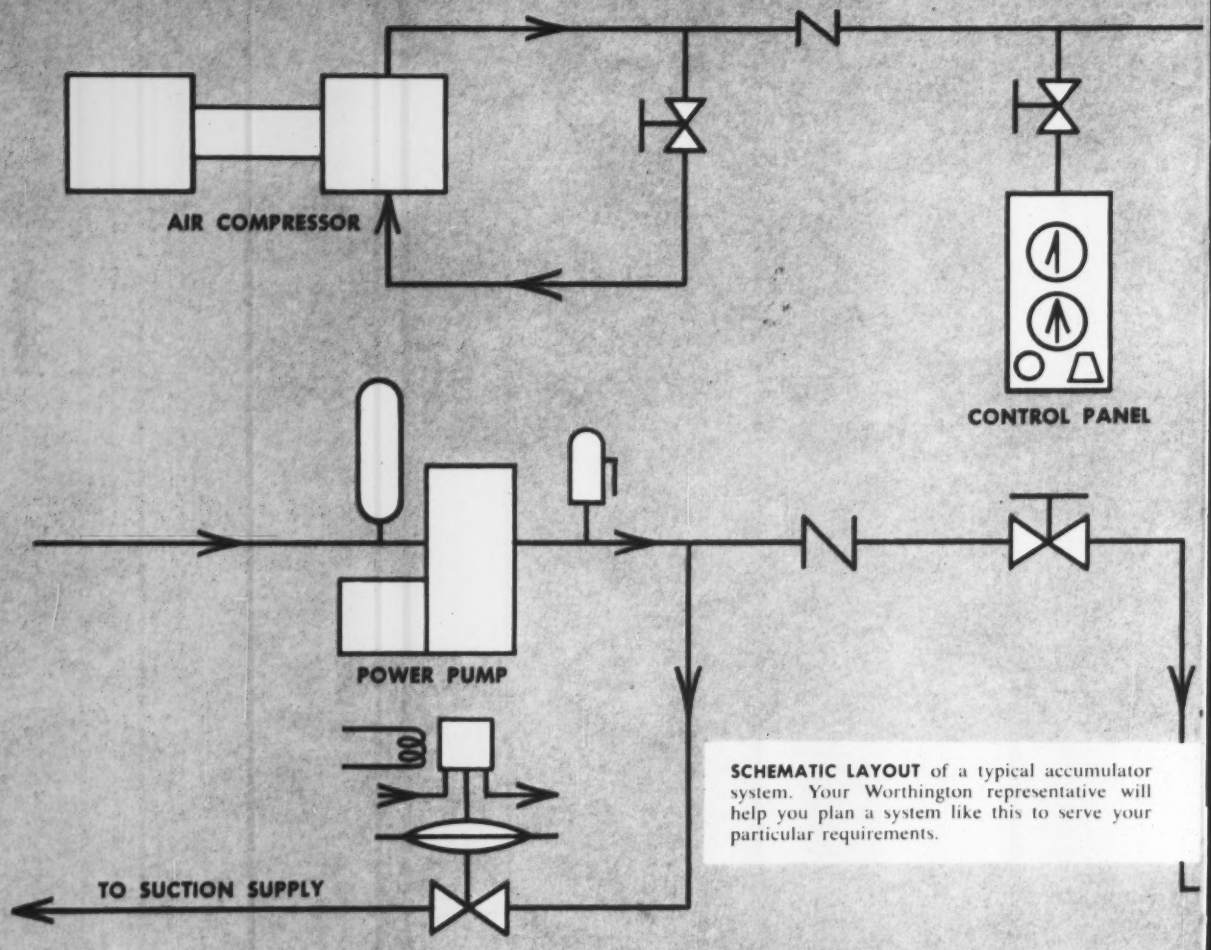


SCHEMATIC LAYOUT of a typical accumulator system. Your Worthington representative will help you plan a system like this to serve your particular requirements.

HOW TO SELECT A CENTRAL HYDRAULIC

This is an important part of good advance planning if you are to take advantage of one of the major benefits of an air bottle system as opposed to the other types.

Water versus oil

Several recent accidents have made manufacturers and insurance companies conscious of the dangers of flammable hydraulic fluids. The slightest leak at high pressure can throw flammable oil 30 or 40 feet. This is highly dangerous, especially for press applications which involve red hot or molten metals.

One way to lick the problem is by using non-flammable oils—but these cost about $3.50 a gallon, seven times as much as straight hydraulic oils. When you consider that large plants lose as much as 25,000 gallons per year by leakage, you'll realize why they are not widely popular. Also some types are toxic to the skin.

The trend is definitely to the use of water as the hydraulic medium. By adding up to 5% soluble oil, you can lubricate valves and press rams at little expense without making the mixture flammable. Worthington strongly recommends that you play safe and power your hydraulic equipment with water.

Close-clearance, high-pressure rotary gear or radial or axial piston pumps wear out quickly on water. Be sure you get the right type of reciprocating power pump, centrifugal or direct-acting steam pump for your central system.

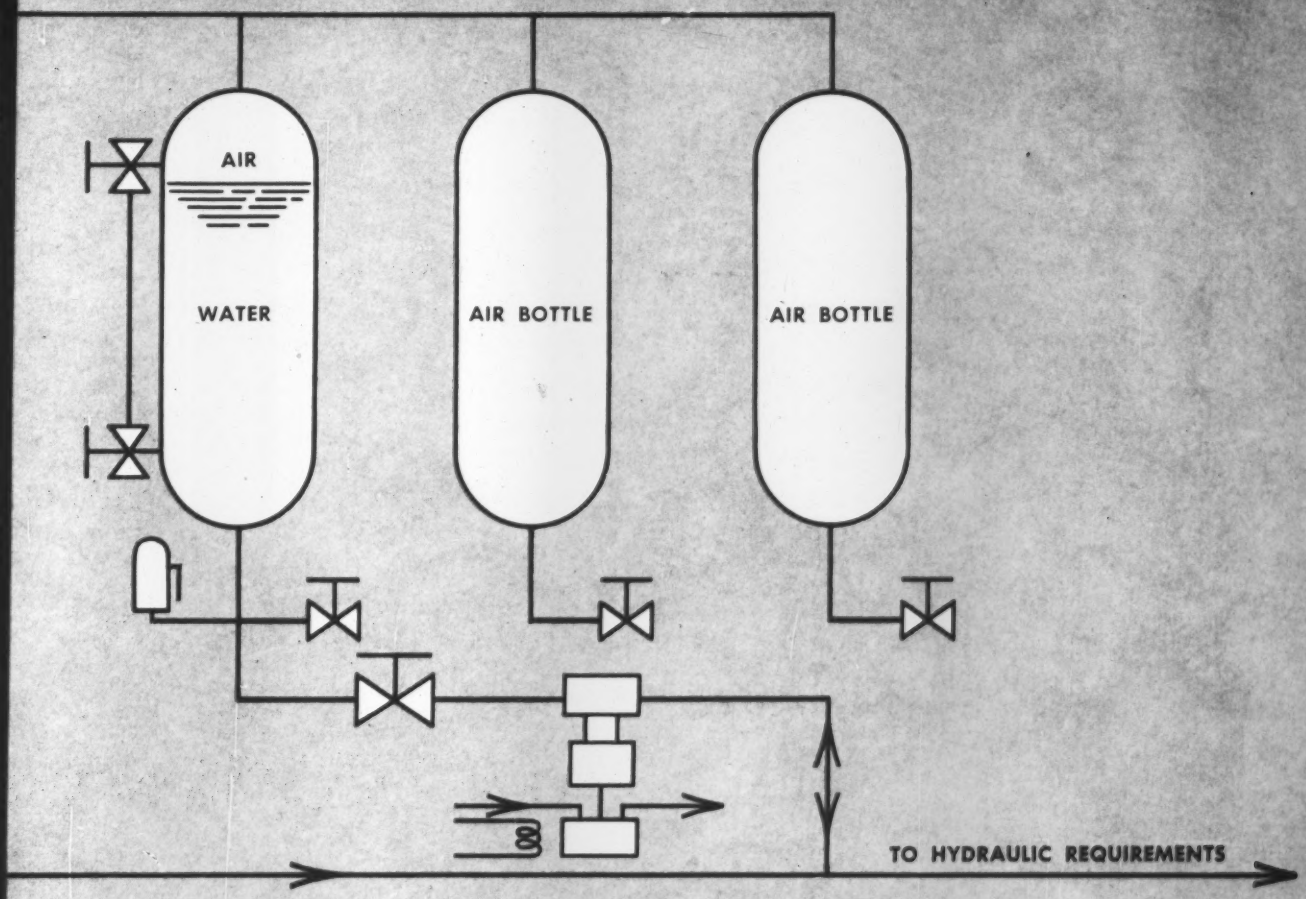
Beforehand planning assistance

More and more operators are finding that they can save time, trouble and expense by calling on the specialized knowledge of equipment manufacturers in the early stages. Worthington, for example, offers you help in four important areas: engineering and design, equipment recommendations, equipment coordination, and conversions.

To obtain a low-cost, reliable hydraulic system geared to the requirements of your particular application, proper design is most important. Your Worthington representative has worked with many plants in the preliminary stages. He can help you determine specific requirements of your installation. This information is then forwarded to our Oil City headquarters where experienced hydraulic design specialists prepare a preliminary system layout with a bill of material listing recommended high pressure components. There is no charge for this service.

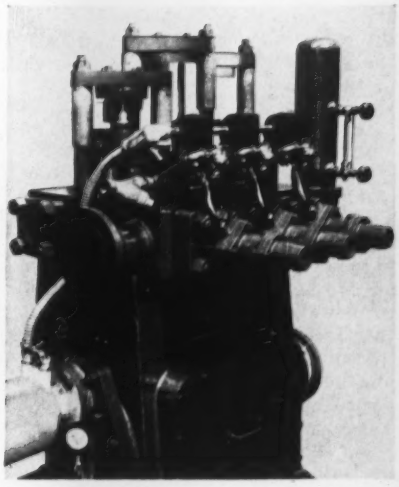
Equipment recommendations

For most efficient performance, you'll want to make sure that you consider all equipment alternatives. For example, depending on the economics of your application, you can select either a reciprocating or centrifugal pump. Because Worthington makes both types we're in an ideal position to help you with pump selection. In the same way, your Worthington representative can help you specify the most appropriate accumulator, central control panel, compressor, and other auxiliaries.



ACCUMULATOR SYSTEM (CONTINUED)

A typical smaller installation. This accumulator system—engineered, designed, and supplied by Worthington—furnishes hydraulic pressure for a rubber molding plant in Rhode Island.



Automatic unloading control. For intermittent operation, synchronized suction valve unloaders are available from Worthington. These patented devices provide quick reduction in fluid delivery.

60 years of experience. Worthington has built equipment for hydraulic pressure systems since 1897. Your Worthington representative can assist you in many engineering and design problems.

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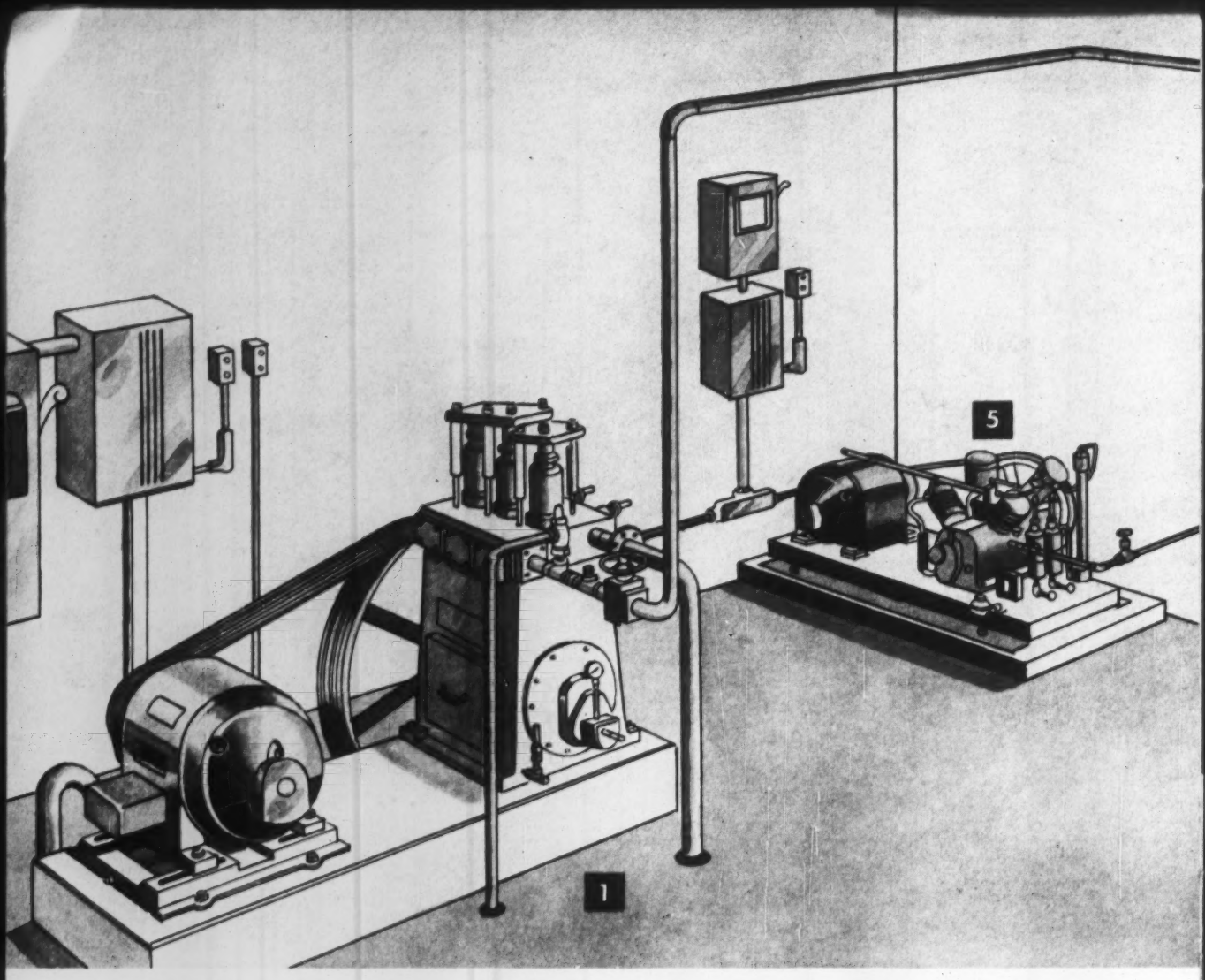


HOW TO SELECT A CENTRAL HYDRAULIC

Equipment co-ordination

By pin-pointing the responsibility with one supplier, you assure that the equipment will arrive co-ordinated, ready to install. You also relieve yourself of the thousand-and-one details that are a part of the co-ordination job. Worthington is the company that can engineer, design, and supply the complete system.

Installation help

Worthington can also help you get your system installed and operating on time with a minimum of delays and added expense. When you buy the complete package from Worthington, for example, you get detailed instructions for the installation of each component. Each item is properly co-ordinated and shipped to arrive at the most appropriate time. The services of a trained installation expert, who has supervised many other such jobs, is also available at a nominal cost from Worthington. Pipe and piping installation can best be handled by local contractors. Worthington engineers will review your detail pipe drawings.

Conversion help

Should you need to enlarge your present system, or convert from individual pumps to a centralized accumulator system, your Worthington representative can also lend his specialized assistance. He has a broad knowledge of problems faced by other companies in similar situations. In order to take maximum advantage of his experience, however, he should be called in early in the discussion period.

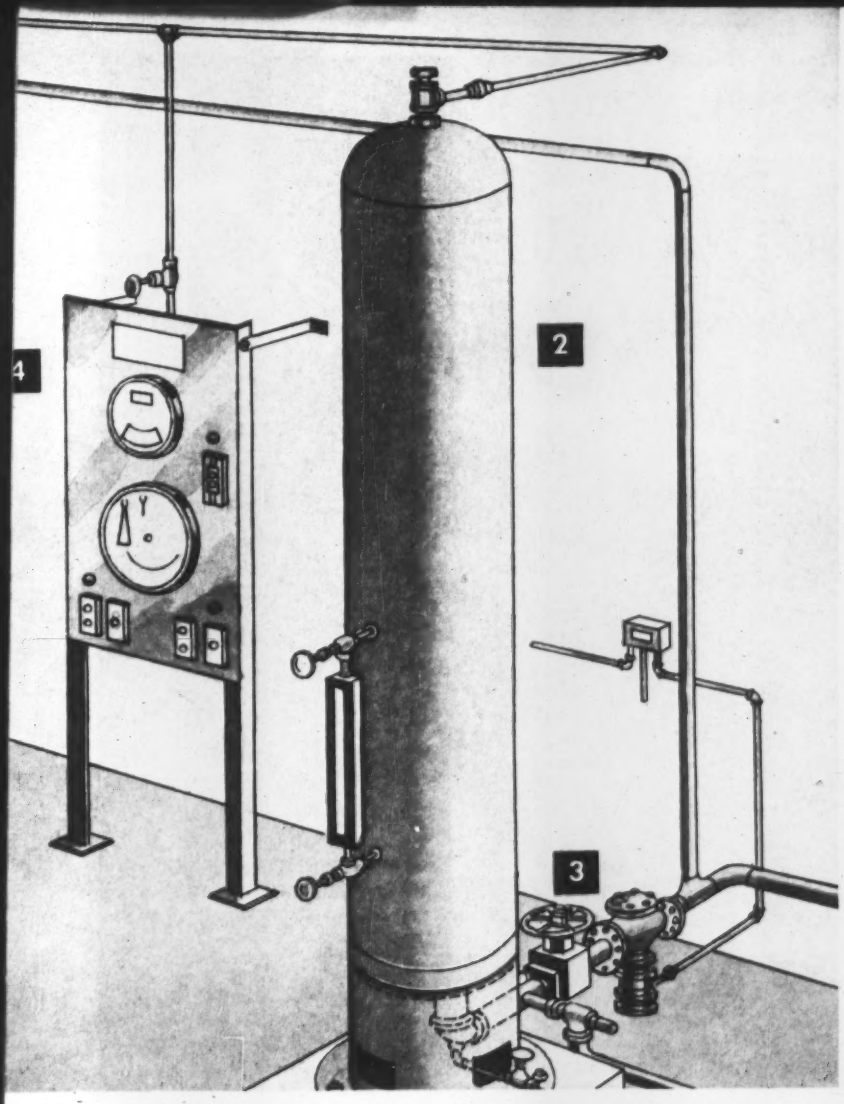
In addition to specialized engineering and design help, you benefit in other ways by selecting a Worthington packaged hydraulic system.

Rugged equipment. The "heart" of an accumulator is the power pump. The Worthington unit is rugged, dependable and accessible. Many of the refinements you find on Worthington units are based on the requirements of oil field service, where the pump must operate continuously for 5 to 10 years and yet be highly accessible for fast, easy maintenance.

The liquid cylinder, for example, has large fluid passageways bored from solid forgings for maximum strength. A Worthington power pump has marine-type connecting rods and one-piece forged steel crankshafts. All bearing surfaces and running parts are pressure lubricated.

For easy maintenance, there are individual valve hole covers and extra deep stuffing boxes with interchangeable plunger sizes.

Patented automatic control. For intermittent operation, Worthington's exclusive synchronized suction valve unloaders efficiently and economically control Worthington power pumps. Built around an electric synchronizing distributor, these patented units unload each cylinder in sequence on the suction stroke, providing quick but gradual reduction in fluid delivery from full to zero flow in not more than one-half revolution. Loading is accom-



A complete Worthington hydraulic accumulator package consists of the following equipment:

1. Pump—A vertical triplex pump is illustrated here, with forged steel liquid end and synchronized suction valve unloaders. Or alternately, you can choose a vertical multiplex or horizontal duplex from the world's broadest line of pumps. For large systems, centrifugal pumps may be recommended.

2. Accumulator—Direct air-water contact type with no moving parts to wear or cause leakage. Built of rolled and welded steel plate to A.S.M.E. and local codes. Includes illuminated, high-pressure level gage.

3. Accumulator Safety Shut-off Valve—closes instantaneously and automatically if accumulator water level drops abnormally. Prevents loss of accumulator air into system, protecting presses and avoiding shut-down for re-charging.

4. Control Panel—Packaged control center with recording pressure instruments for loading and unloading pumps as accumulator level varies with system demand. Also indicating pressure controls for over-pressure pump shutdown and underpressure closing of safety shut-off valve. Complete with audible alarms and lights, switches and relays all mounted and wired.

5. Compressor—Worthington four cylinder, three-stage air cooled type for charging the accumulator on initial startup and periodic replenishment. Includes motor, base, belt drive, valves, and controls.

ACCUMULATOR SYSTEM (CONCLUDED)

plished in the same manner.

Co-ordinated auxiliaries. All auxiliaries that make up a Worthington package system are completely co-ordinated and built to the same high standards of quality as the power pump. The accumulator, control panel, compressor, and accessories have proved themselves in thousands of industrial installations across the country.

We welcome your inquiries

For more information about selection and application of hydraulic accumulators, get in touch with your nearest Worthington representative. Or write to us for a copy of a file folder containing helpful technical data on accumulators and their application. Worthington Corporation, Power Pump Department, Oil City, Pa. In Canada: Worthington, Ltd., Brantford, Ont.

WORTHINGTON

Worthington equipment for hydraulic descaling. Descaling of billets, strips and slabs saves waste, improves quality, and reduces wear on tools and rolls or forging dies. Worthington hydraulic experience can help you plan an efficient, economical descaling system.

WORTHINGTON CORPORATION
Power Pump Department, Section P-72
Oil City, Pennsylvania

Please send us your file folder on hydraulic accumulator systems
(check one)

☐ For a specific project

☐ For reference

NAME _____

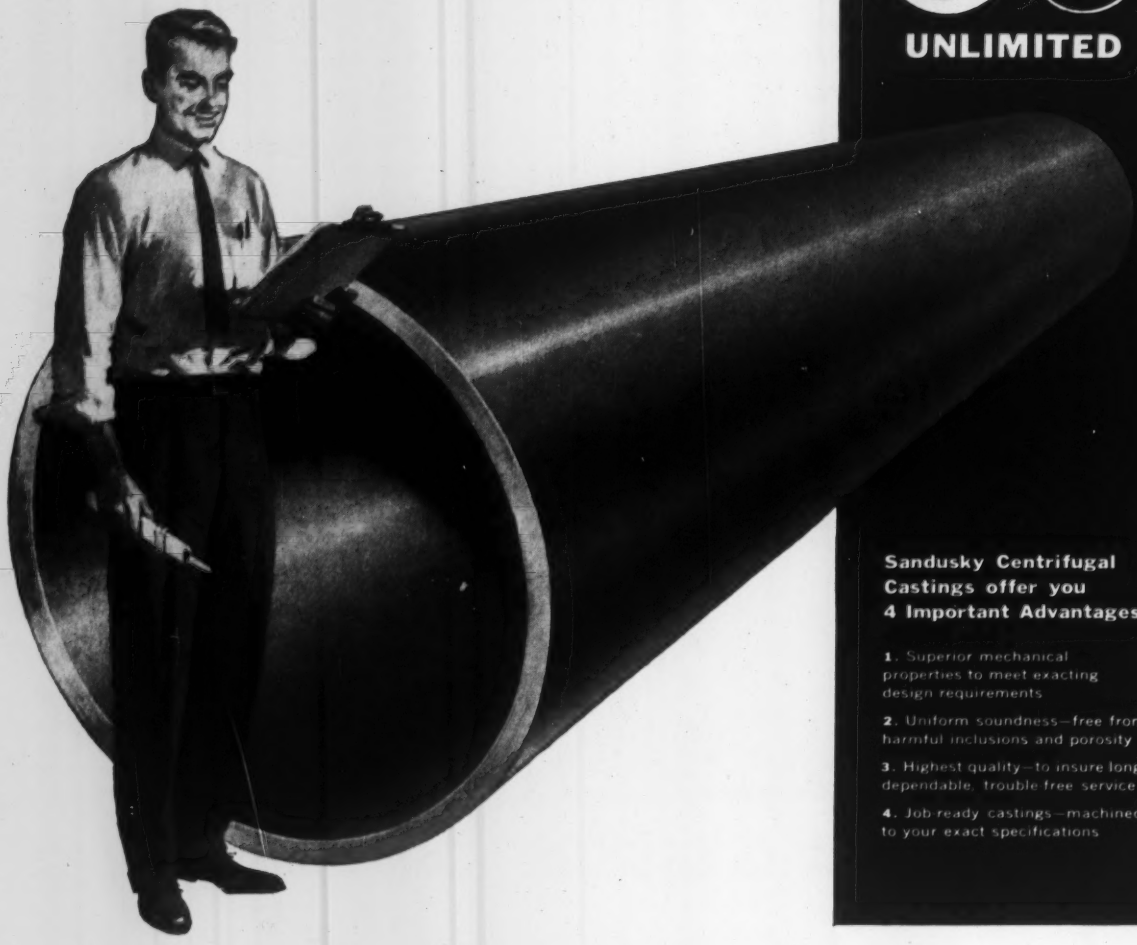
COMPANY _____

ADDRESS _____

CITY AND STATE _____

CYLINDRICAL APPLICATIONS:

UNLIMITED



Sandusky Centrifugal Castings offer you 4 Important Advantages

1. Superior mechanical properties to meet exacting design requirements
2. Uniform soundness—free from harmful inclusions and porosity
3. Highest quality—to insure long, dependable, trouble-free service
4. Job-ready castings—machined to your exact specifications

More and more design engineers are realizing that new applications for centrifugal castings are *unlimited* . . . thanks to new knowledge about alloys . . . new casting and machining techniques and facilities.

From simple bushings to atomic reactor components . . . from bronzes to heat, corrosion, and abrasion resistant stainless steels . . . from 7" to 54" O.D. and lengths to 33 ft.—Sandusky centrifugal castings are providing gratifying results in scores of applications, many unheard of a few years ago.

What cylindrical or piping problem can we help you solve? . . . Code pressure vessels? . . . Reactor vessels? . . . Power Piping? . . . What is your problem?

Your inquiry will bring more information promptly . . . or, if you prefer, a personal call by one of our engineers.

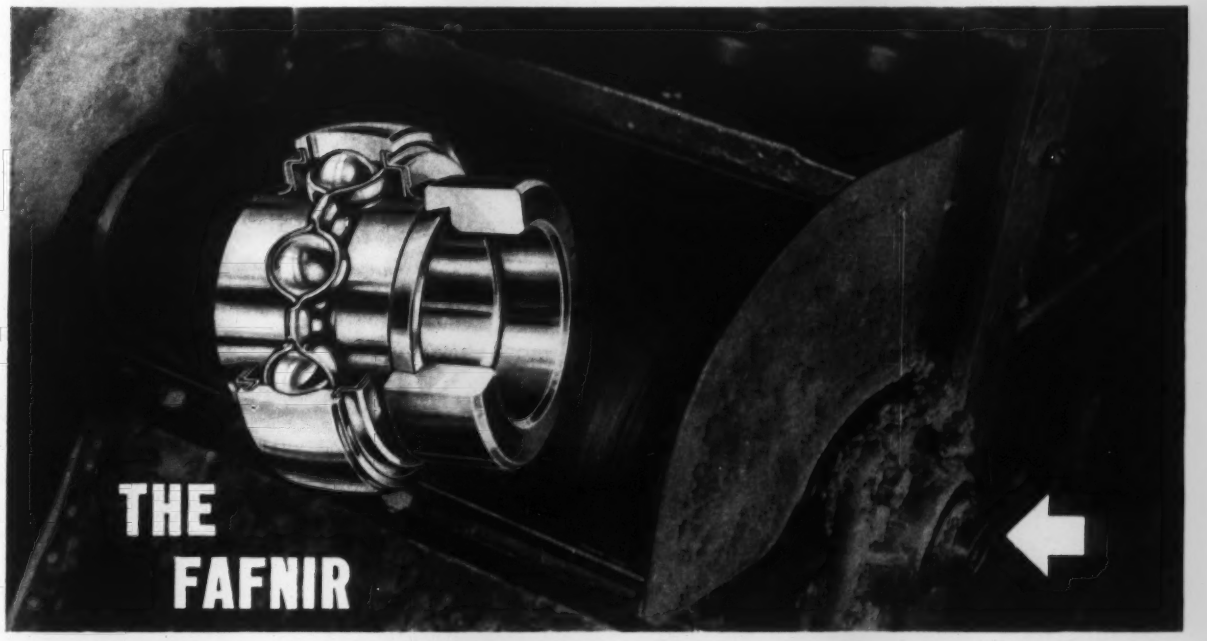
CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Company

SANDUSKY, OHIO • *Stainless, Carbon, Low Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys*

See our Display in Booth No. 1731 at the METAL SHOW

TWO GREAT BEARING DEVELOPMENTS ROLLED INTO ONE!



PLYA-SEAL WIDE INNER RING BALL BEARING

Designed expressly for slow speed applications and wet or dirty operating conditions

New Fafnir Plya-Seal Wide Inner Ring Ball Bearings are a combination of two outstanding bearing developments. The most effective seal ever devised for retention of grease and protection against contamination, plus the famous Fafnir self-locking collar, for cost-cutting, twist-of-the-wrist bearing installation. This combination of features offers you several advantages . . .

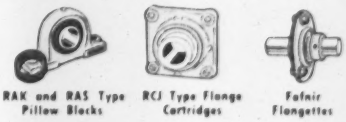
Best protection yet against dirt, dust, steam, water, lint, other contaminants on slow to moderate speed applications. Contact-type, Plya-Seals seal out abrasive or corrosive material, seal in factory prepacked lubricant.

Less Maintenance — In many applications, non-relubricatable bearings may be used. They require virtually no maintenance time or expense. In other applications, where bearings receive hard or constant use, relubricatable types are available. They require only occasional greasing, even under severe conditions.

Longer Service life — Plya-Seals protect against premature bearing wear or failure. Contaminants cannot damage balls or races; sealed-in lubricant ensures against bearing "running dry".

Simplified Designing — Bearing housings may be designed without incorporating separate housing seals. Plya-Seals provide full protection; make possible simplified, less costly, more compact housings.

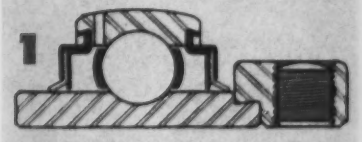
Power Transmission Units incorporating new Fafnir Plya-Seal Wide Inner Ring Bearing



RAK and RAS Type Pillow Blocks | RCJ Type Flange Cartridges | Fafnir Flangettes

Write for bulletin containing complete specifications on Fafnir Plya-Seal Wide Inner Ring Ball Bearings and Power Transmission Units. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA



1

PLYA-SEALS

As incorporated in the Fafnir Plya-Seal Wide Inner Ring Ball Bearing, the Fafnir Plya-Seal consists of a synthetic rubber-impregnated fabric sealing washer sandwiched between dished steel plates. Seal flares out, maintaining constant contact with ground outside diameter of inner ring. Years of service have proven Plya-Seals the most effective seal ever developed for ball bearings.

2

SELF-LOCKING COLLAR

Originated by Fafnir, this famous development has cut costs and simplified assembly throughout industry. Bearings slip onto shaft; are locked securely with simple twist of self-locking collar. No need for lock nuts, shoulders, sleeves, washers, or adapters. Positive binding action increases with use.

In Iron Body Wedge Gate Valves,
Outside Screw and Yoke Design,

Walworth offers you these 8 outstanding advantages!

STRONGER CONNECTIONS. T head disc to stem connection on OS&Y types permits wedge to properly seat itself.

TIGHTER SEAL. Solid web type disc on OS&Y valves provides tight closure, greater strength and longer service.

REDUCED TURBULENCE. Fluid action is minimized due to this straight flow port design.

FEWER OBSTRUCTIONS. Seat rings of bottom seated types are screwed into body to prevent gum and grit accumulations.

*WALWORTH is a registered trademark of WALWORTH COMPANY

Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. · CONOFLOW CORPORATION · GROVE VALVE AND REGULATOR CO.

SURE-GRIP HANDWHEEL. Fluted design assures a sure grip, even with greasy gloves.

HIGH CORROSION RESISTANCE. Brass liner protects glands from deterioration and scoring.

EASIER REPACKING. Hinged gland eye bolts on OS&Y valves permit fast maintenance under full pressure.

LESS DAMAGE. Bronze back-seat bushing in bonnet of OS&Y valves prevents scoring, guides stem accurately

Walworth Iron Body Gate Valves are available with screwed or flanged ends, in sizes and types for every purpose. For full information see your Walworth Distributor or write: *Walworth Company, 60 East 42nd Street, New York 17, N. Y.*

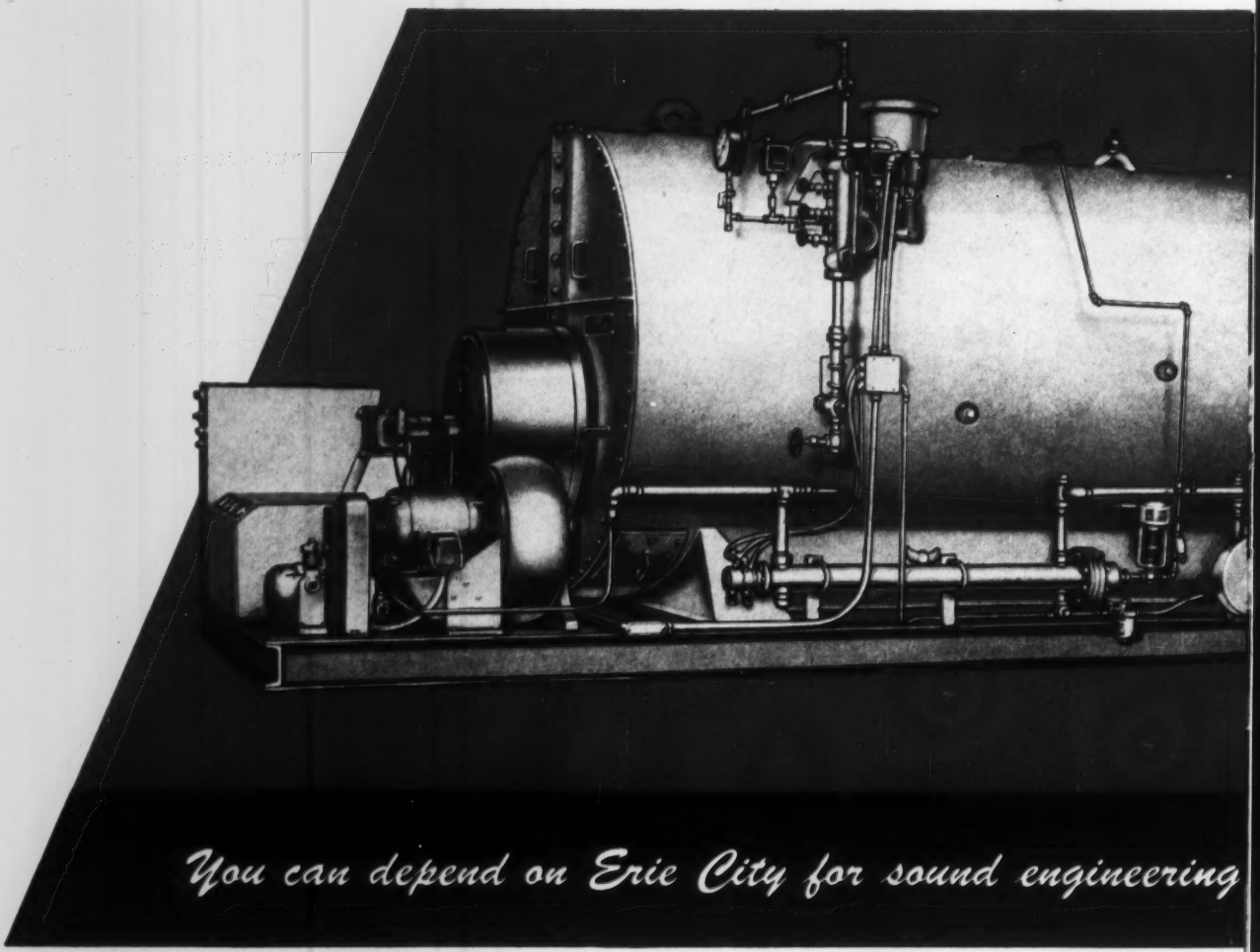
WALWORTH*

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

M & H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING AND WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

ERIE CITY FT

the small boiler package



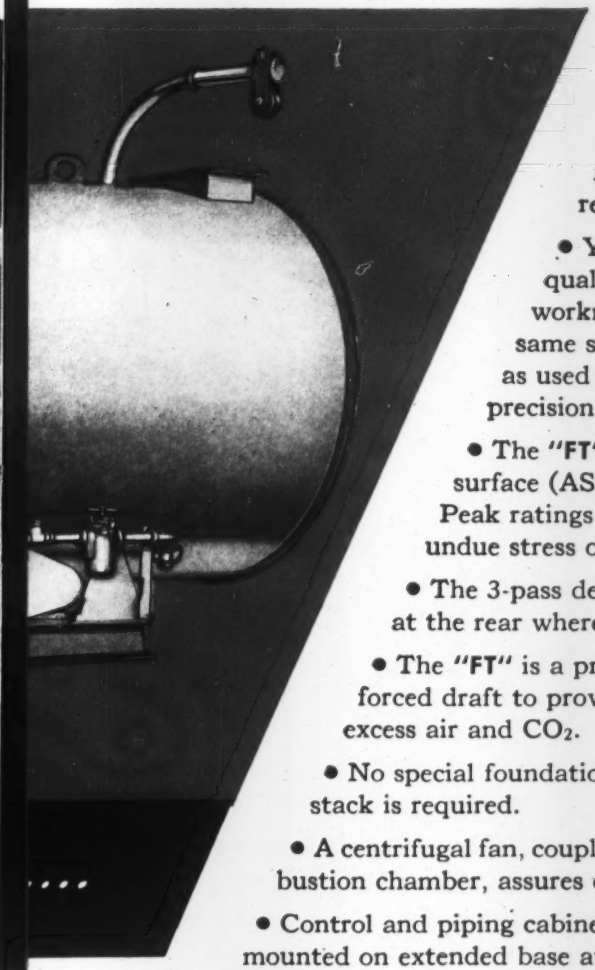
You can depend on Erie City for sound engineering

ERIE CITY
117 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

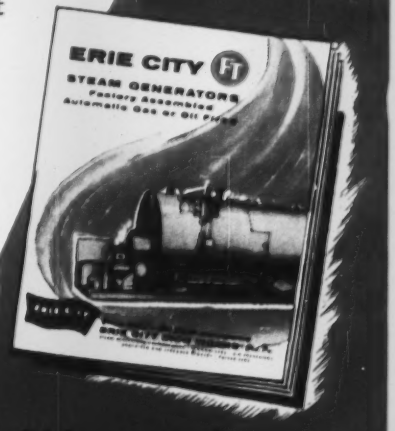
STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

for "PUSH BUTTON" steam with big boiler quality ~~~



Backed by over a century of experience manufacturing high pressure water and fire tube boilers — the **"FT"** is manufactured, assembled, completely wired, piped and *factory fire tested*. It comes to you ready to go to work.

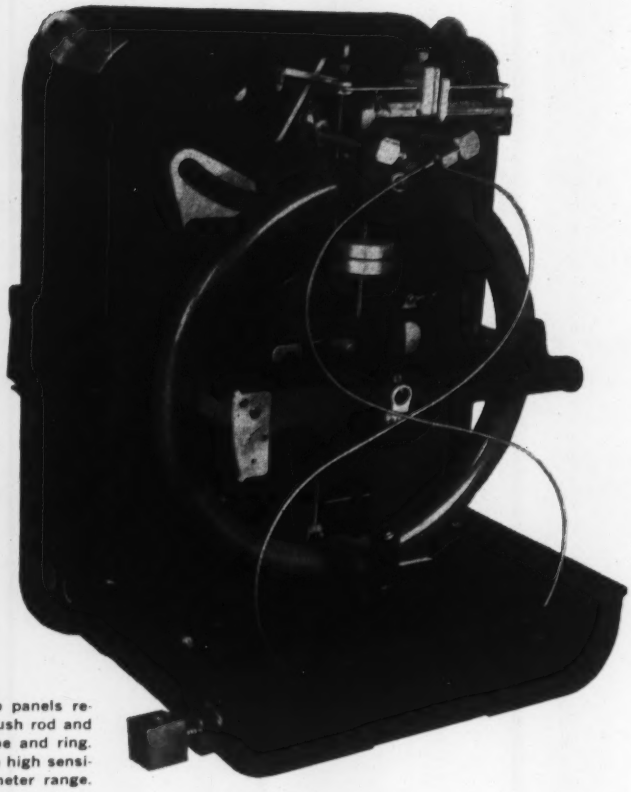
- You can be sure that the **"FT"** uses top quality materials — the same skilled workmanship — the same welding — the same stress-relieving and X-ray techniques as used on Erie City high pressure, precision built industrial power boilers.
- The **"FT"** has 5 full square feet of heating surface (ASME basis) per developed hp. Peak ratings are easily attainable with no undue stress on the boiler.
- The 3-pass design places the gas vent at the rear where it belongs.
- The **"FT"** is a pressurized unit using forced draft to provide precise control of excess air and CO_2.
- No special foundation nor expensive stack is required.
- A centrifugal fan, coupled to a closed combustion chamber, assures quiet operation.
- Control and piping cabinets are mounted on extended base away from heat and vibration.
- Every safety device is provided including indicating lights for "Power On"— "Ready"—"Pilot On" and "Main Flame."
- For the complete description of this top quality **"FT"** package that may cost a little more — but is worth it — write for SB-564J.



Did you send for your copy of CATALOG SB-569H

HAGAN RING BALANCE FEATURES—NO. 2

SAFE SENSITIVE METERING at 2500, 6000, 15000 PSIG



Rear of Ring Balance Meter with side and top panels removed to show S-tube arrangement. Note the push rod and resistant spring assembly, visible back of S-tube and ring. This feature of the Ring Balance makes possible high sensitivity at low flows and simple adjustment of meter range.

No question about it. The cylindrical tubing used to form the ring and S-tubes of the Hagan Ring Balance meter is the safe, sure means for containing high pressures. There are no gaskets or stuffing boxes to leak, blow out, bind or otherwise spoil this ideal design.

Pressure impulses are brought from the meter terminals to the ring through solid-wall S-tubes which, because of their special configuration and metal-to-metal fittings, provide safe, completely flexible connections and preserve the inherent high sensitivity of the meter.

New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

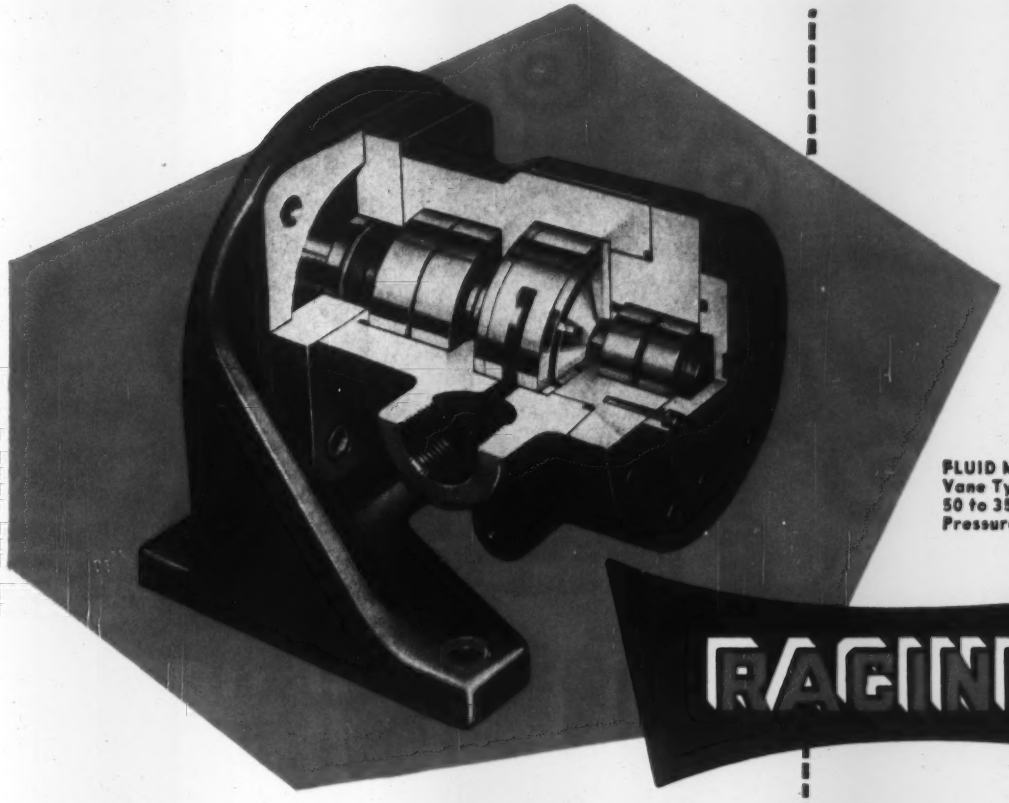
Check these other Ring Balance features with your local Hagan office

1. High sensitivity at low flows due to unique range calibration system.
2. Ease of calibration under operating static pressures with factory-calibrated check weights. No more four-story water columns and telephones.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON



FLUID MOTOR
Vane Type
50 to 3500 rpm
Pressures to 1500 psi

RACINE®

A BETTER SOURCE OF ROTARY FORCE

Simple, compact and rugged in design, a RACINE Vane Type FLUID MOTOR transmits efficient hydraulic horsepower.

Note its simplicity and the minimum of moving parts, all of which are self-compensating for wear. Extra capacity bearings, heavy-duty shaft, tool steel vanes and alloy steel rotors, all contribute to efficient, dependable performance and maximum operating life.

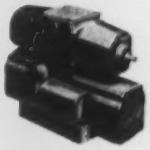
RACINE Vane Type FLUID MOTORS are available in several sizes with maximum output to 22 horsepower. Speeds from 50 to 3500 RPM — operating pressures to 1500 PSI.

Write today for full details. Let us show you why RACINE can give you "A Better Source of Rotary Force."

OTHER RACINE HYDRAULIC PRODUCTS

MODEL Q
Variable Volume
Vane Type
Hydraulic Pump

PRESSURE BOOSTER
Up to 5000 psi
Up to 7:1 pressure ratio



4-WAY VALVE
Twin Solenoid
Pilot Operated

RESERVOIR
With Control Panel
Designed to your space
and circuit requirements

RACINE

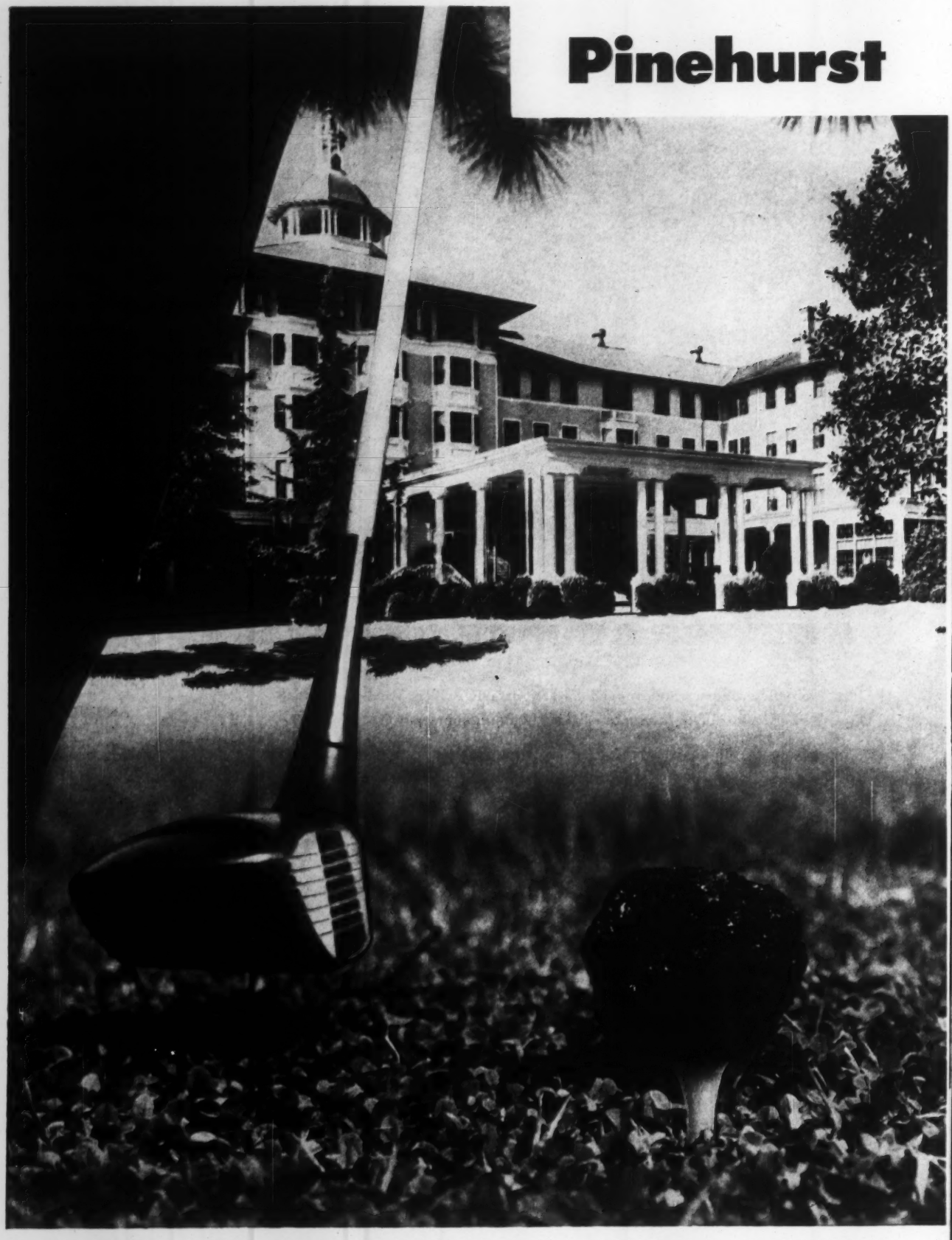
NFPA NATIONAL FLUID POWER ASSOCIATION

Member

RACINE HYDRAULICS & MACHINERY, INC.

2076 Albert Street
RACINE, WISCONSIN, U. S. A.

Pinehurst



tees off on fuel costs

Golfing resort cuts costs 33% with modern burning of coal

The central power plant at the famous golfing resort of Pinehurst, N. C., has to furnish a reliable supply of steam to three hotels and seven other buildings.

When Pinehurst recently decided to modernize power facilities, the consulting firm of Wiley and Wilson, Richmond, Va., was called in to study the situation. Since coal cost approximately 40% less than the nearest competitive fuel, the final decision called for burning coal the modern way. Today two new automatic stoker-fired boilers (only one of which is operated at a time) replace four 150-HP hand-fired boilers. Combustion control is automatic; coal and ash handling is greatly simplified. And now, according to management, "the cost of generating steam is 33.4% less than with the old plant."

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at a stable price.

Technical advisory service

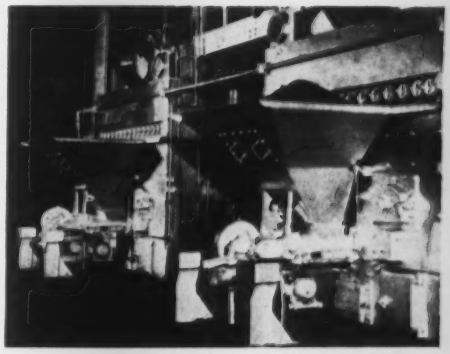
The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

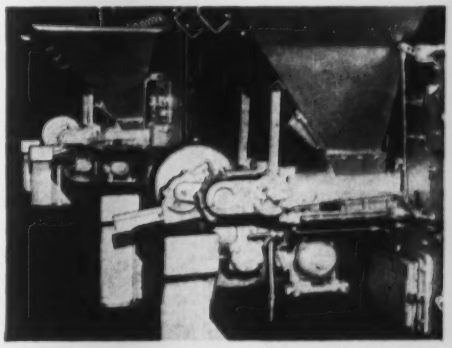
If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

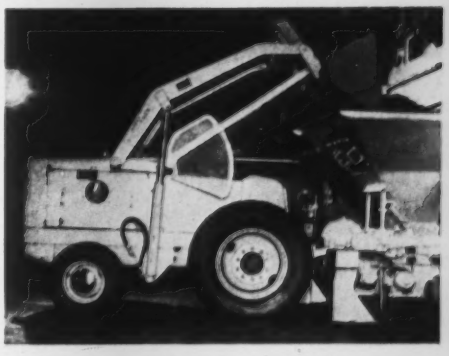
Southern Building • Washington 5, D.C.



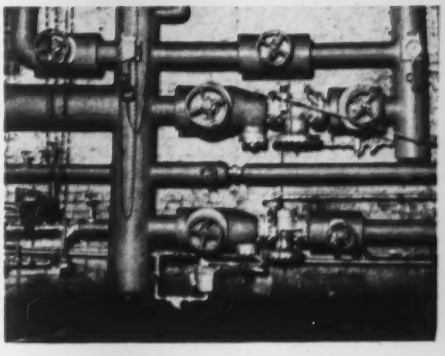
Two Babcock & Wilcox type FF integral-furnace boilers supply all the steam for Pinehurst at about 125 pounds pressure at 600° F. Average steam load is 11,000-12,000 pounds per hour per day.



Close-up of stokers. These underfeed, single retort, side-dump models are made by Detroit Stoker. They operate automatically, each driven by a 3 HP enclosed motor.



Frank G. Hough Payloader transfers coal from railroad trestle to storage, from storage to stokers. Payloader also facilitates handling of ash disposal.



Readily accessible, all of the steam distribution lines are taken off a manifold in the engine room. Five separate lines with Ruggles-Klingemann automatic pressure regulators distribute the steam at the required pressure in each case.

Always Stronger Than They Need Be!

MIDWEST

WELDING FITTINGS

Below are photographs of two of the many tests that have been made of Midwest Welding Fittings. The results are *always* the same . . . the seamless pipe to which the fittings are welded invariably bursts. There is *never* any sign of fitting failure or weakness.

There's good reason for this. We make elbows and tees of inherently stronger metal . . . the Midwest exclusive method of manufacture enables us to maintain greater minimum wall thickness, and to reinforce the fittings at points of greatest stress. For the many other advantages of Midwest Fittings, ask your Midwest distributor or write us for Catalog 54.

MIDWEST PIPING COMPANY, INC.

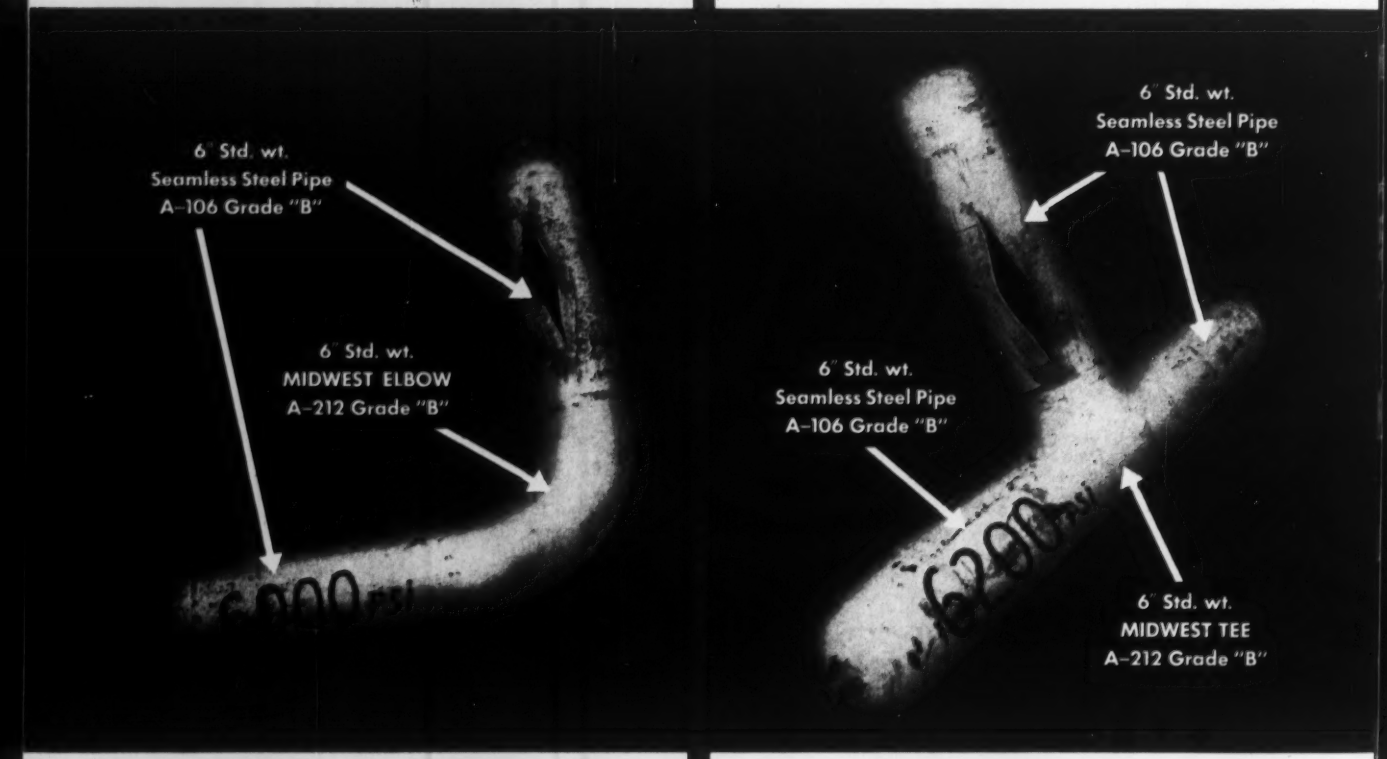
Main Office: 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

ASHEVILLE (BOX 446, SKYLAND, N. C.) • BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST. • CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE. • LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD. • NEW YORK 7—50 CHURCH ST.
ONEIDA, N.Y.—282 NORTH MAIN ST. • SAN FRANCISCO 11—420 MARKET ST.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES



Typical bursting test of stock Midwest Welding Elbow. As is always the case, failure occurred in the seamless pipe while the elbow was undamaged. Bursting pressure was 6000 psi . . . considerably above the required code minimum for seamless pipe. (Minimum allowable bursting pressure for 6" standard weight A-106 Grade B seamless steel pipe is 4438 psi.)

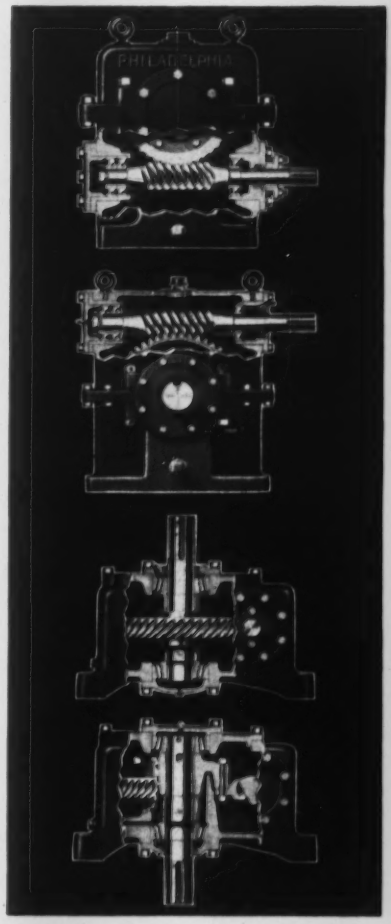
Bursting test of Midwest Welding Tee taken at random from stock. As always, the failure occurred in the seamless pipe and not in the fitting. The non-shock internal bursting pressure of 6200 psi is well above the code minimum for seamless pipe. (Minimum allowable bursting pressure for 6" standard weight A-106 Grade B seamless steel pipe is 4438 psi.)

7761

MIDWEST **WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS**

Quality is *inherent*, Service and Long Life *proven*...

Philadelphia WORM GEAR REDUCERS



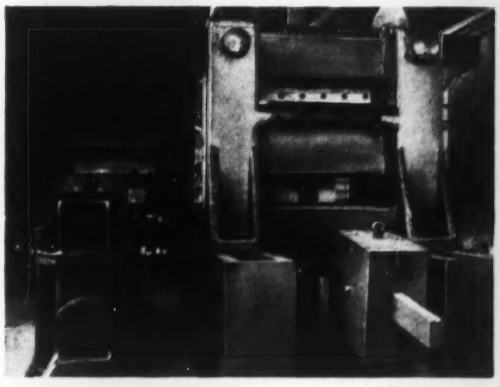
Whether you desire just worm and worm gear sets, or complete self-contained Worm Gear Speed Reducers — Phillie Gear is capable of meeting your most exacting requirements.

Philadelphia Worm Reducers are available in single or double reductions in horizontal right angle drive types, with the output shaft above or below the worm shaft — and in single or double vertical types, with output shaft extending up or down. Standard reductions in the single type are up to 90 to 1, and the double reduction types from 102 to 1, to 6300 to 1.

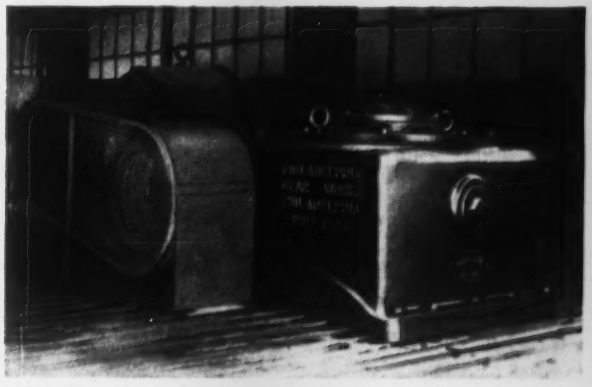
All sizes and types of Philadelphia Worm Reducers provide efficient, smooth and dependable power transmission under the most rigorous and severe operating service — Thousands are in daily use in industry throughout the World.

For detailed information, write for Catalog WG-562, and please use your Business Letterhead when requesting your copy.

a type and size for any requirement



Type AT Philadelphia Worm Reducer driving 44" Up-cut Hot Shear.



Double Reduction type DVT Philadelphia Worm Gear Reducer on special down-shaft application.

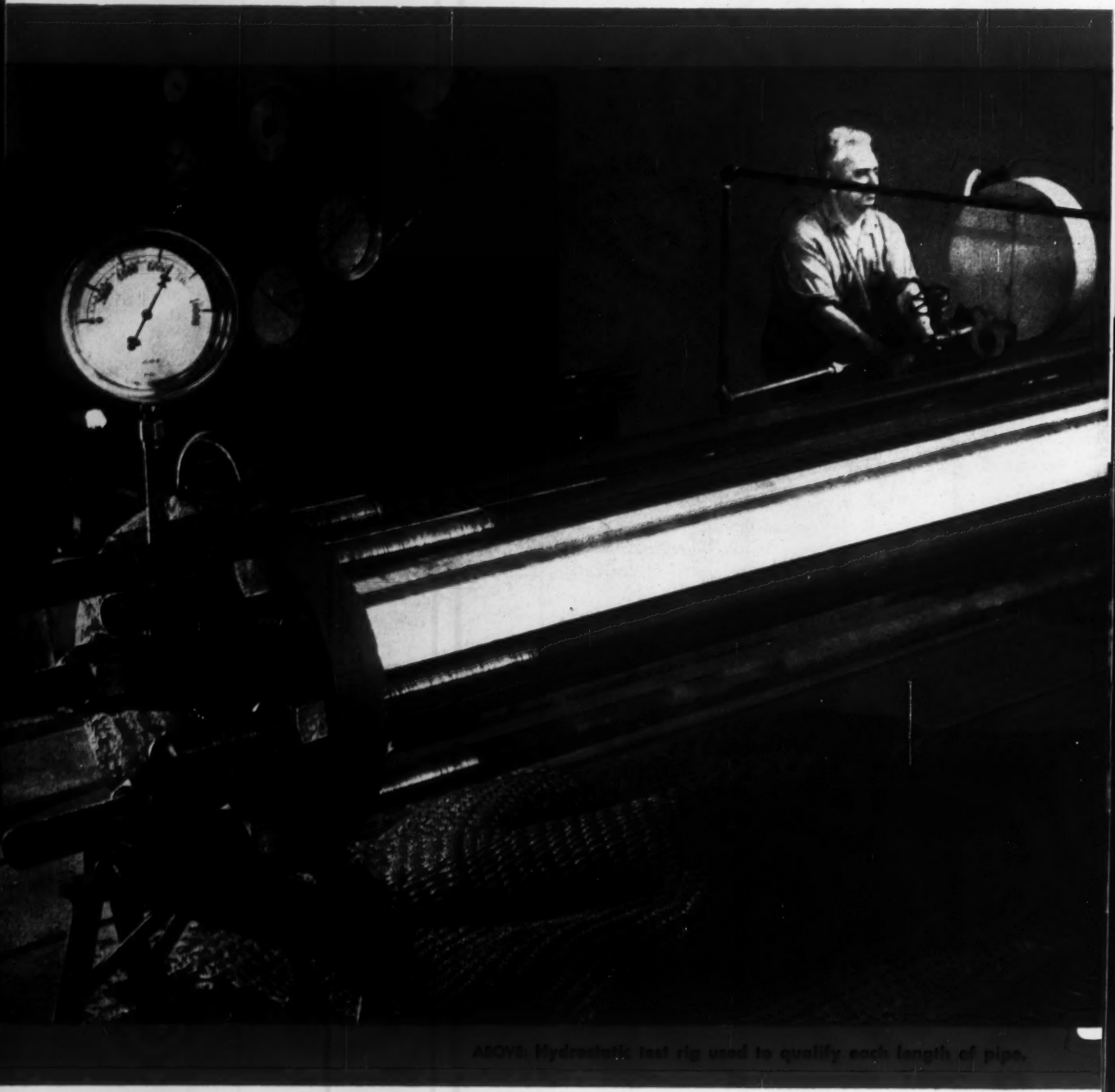
phillie gear ®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

STAINLESS STEEL CENTRIFUGALLY CAST MAY BE



ABOVE: Hydrostatic test rig used to qualify each length of pipe.

UNITED STATES PIPE & FOUNDRY CO.

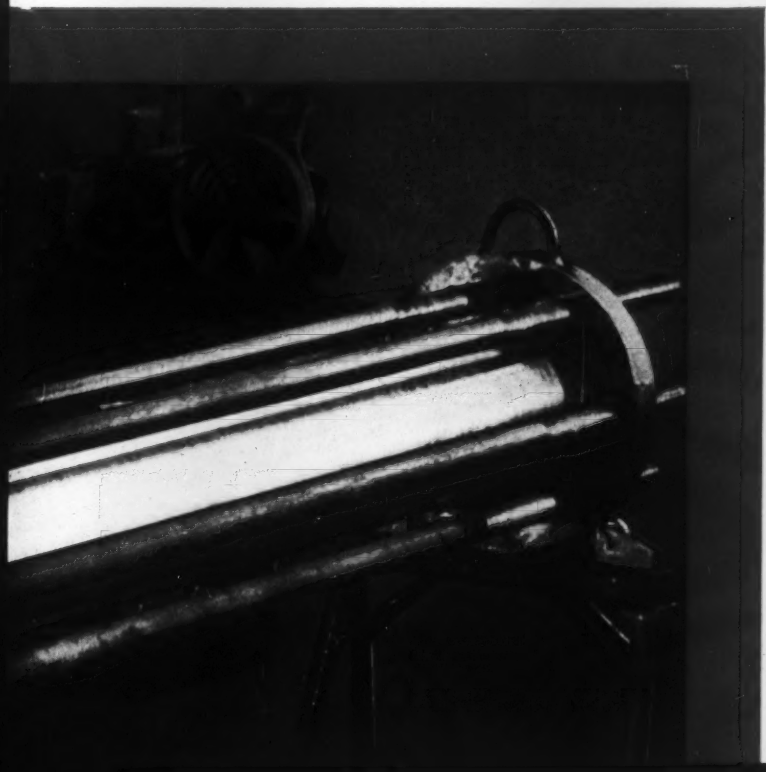
Steel and Tubes Division

STEEL & TUBES — U.S. PIPE — DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, PITTSBURGH, HARTFORD, BURLINGTON

THE ANSWER TO YOUR PIPING PROBLEM



Patented U. S. Pipe process meets rigid refinery specifications

The men who design today's petrochemical plants, refineries or Atomic power plants are confronted with piping problems involving temperatures, pressures and corrosive conditions which only a few years ago would have been called impractical, if not impossible.

U. S. Pipe's Steel & Tubes Division recently completed a piping requirement for 700 feet of Type 316 Extra Low Carbon, columbium-bearing stainless for a large petrochemical plant, which is typical of the job metal mold centrifugally cast pipe is doing today under a patented manufacturing process with rigid Quality Control.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses —in large or small quantities.

Write and outline your refining problems. We may be able to help.

Note these exacting specifications on 316 Cb ELC Stainless Steel Pipe demanded by one of nation's leading oil companies:

MATERIAL REQUIREMENTS: Pipe shall conform to ASTM Specification A-362-52T.

CHEMICAL ANALYSIS: Modified AISI Type 316 Cb (ELC), with *one percent* spread on chrome and nickel.

FINISH: Each pipe to be turned, bored and faced to surface finish of 125 micro inch or better. O.D. tolerance plus 1/16″ minus 0″; I.D. tolerance plus 0″ minus 1/32″. Pipe size: 12″ O.D. × 1.17″ wall.

MECHANICAL TESTS: Tensile Tests — 2 tests required on each pipe after heat treatment; one at room temperature, one at 700° F.

INSPECTION REQUIREMENTS

1. Etching test on sections cut from each end of pipe.
2. Radiographic Inspection — Required complete circumferential coverage of at least an 8″ wide section at each end of each pipe in accordance with ASTM Specification E71-52.
3. Fluid Penetrant — Entire O.D. and I.D. surface each piece.

HEAT TREATMENT: Heat for 4 hours at 2100° F.—2150° F., water quench, follow by 5 hours at 1500° F.—1600° F. Cool in still air.

HYDROSTATIC TEST: Each length tested to stress of either 90% of the minimum cold yield strength or a maximum pressure of 6800 psi —whichever is lower.

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6″ to 50″
Wall Thickness—⅜″ and up
Length—Up to 16′
Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

New!
SPECIAL PURPOSE LOOM
SPECIAL ROLLS REQUIRED

New 380" dryer felt loom manufactured by Southeastern Loom and Machine Works, a Division of Abney Mills. Manufacturers of special machinery for the textile and paper industries, Southeastern recently completed installation of four heavy-duty looms of a type formerly successfully manufactured only in England.

ACIPCO

Centrifugally Spun STEEL TUBES

Rolls in this 380" Southeastern loom, designed for weaving thick dryer felts for the paper industry, must stand extremely heavy loading. Minimum roll deflection and run-out are vital to successful operation.

The long length necessary—33'6"—imposed a requirement for unusual dynamic balance and dimensional stability in these rolls.

Southeastern Loom and Machine Works, a Division of Abney Mills, selected ACIPCO centrifugally spun steel tubes for the let-off and take-up rolls in this new loom. Because ACIPCO's centrifugal process produces tubes with *inherent* dynamic balance and dimensional stability, and because they can be produced in the longer lengths now being specified by modern equipment manufacturers, the selection was right from the start.

When function and design set up unusual or difficult requirements for the tubular steel or alloy iron parts in your application, call on ACIPCO. You'll get a combination of expert technical assistance, manufacturing competence and high quality centrifugally spun tubing that produces successful results.

Let-off and take-up rolls in this Southeastern dryer felt loom were fabricated from ACIPCO centrifugally spun tubing. Large rolls are 33'6" long, with 10½" OD and 2½" wall thickness.

VERSATILE ACIPCO CENTRIFUGALLY SPUN STEEL TUBES

are used in the manufacture of calender, engraving, press, slitter, rewinder, plate cylinder, squeeze and starch bath rolls, as well as in hundreds of other industrial applications.

SIZE RANGE: Lengths up to 410" to meet modern machinery requirements have been produced. OD's from 2.25" to 50"; wall thicknesses from .25" to 4".

ANALYSES: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steel; plain carbon grades and special non-standard analyses.

DISTRIBUTORS

Austin-Hastings Co., Inc.
226 Binney Street
Cambridge 42, Mass.

Peter A. Frasse and Co., Inc.
17 Grand Street
New York 13, New York

Lyman Tube & Bearings, Ltd.
920 Ste. Sophie Lane
Montreal 3, Canada

Vinson Steel & Aluminum Co.
4606 Singleton Blvd.
Dallas 7, Texas

J. M. Tull Metal & Supply Co.
285 Marietta St., N.W.
Atlanta, Georgia

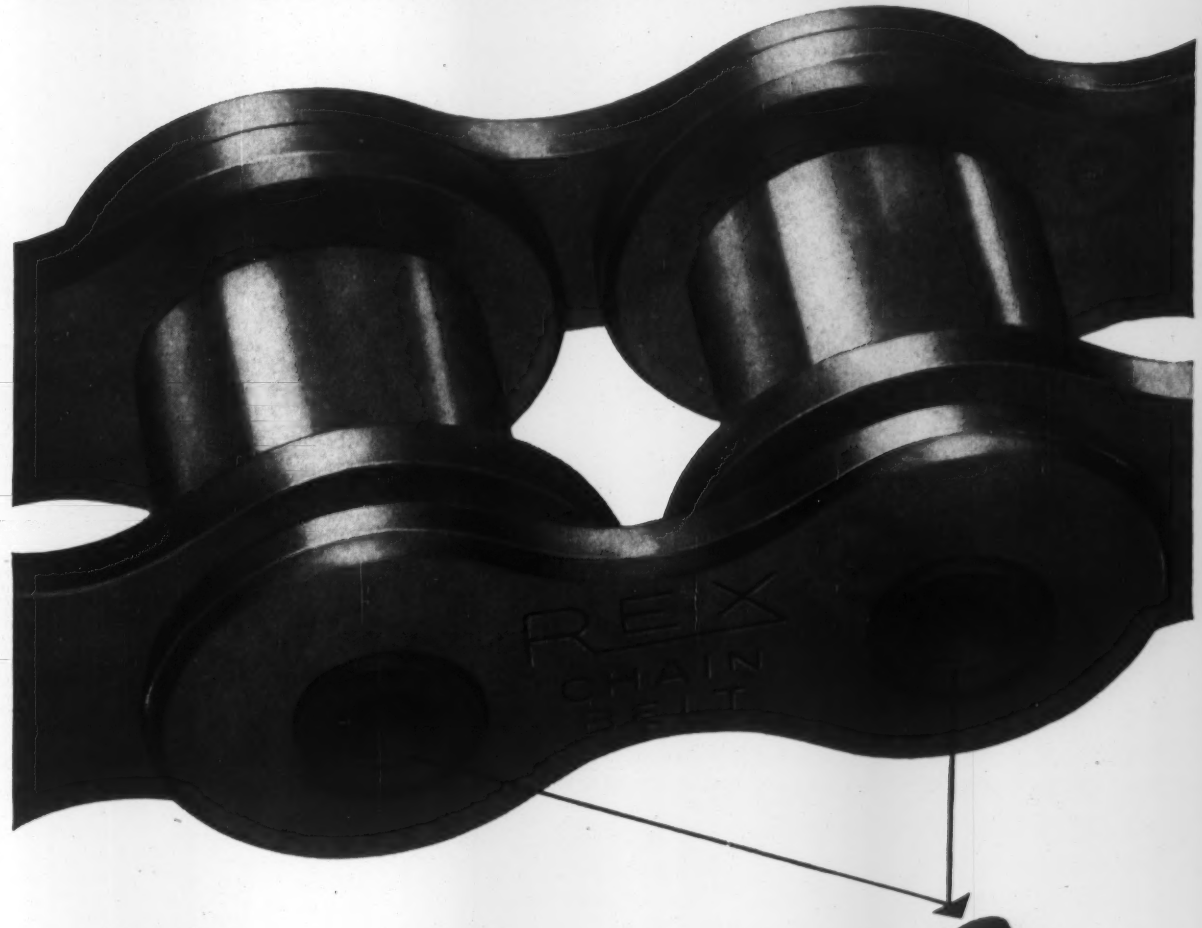
C. A. Roberts Company
2401 Twenty-fifth Avenue
Franklin Park, Ill.

Strong, Carlisle & Hammond Co.
1392 W. Third Street
Cleveland 13, Ohio

Ducommun Metals & Supply Co.
4890 So. Alameda St.
Los Angeles 54, California

AMERICAN CAST IRON PIPE CO.
ACIPCO
Special Products Division
BIRMINGHAM 2, ALABAMA

The story of plus value in Roller Chain...



written on the end of a pin

To provide the long wear life and fatigue resistance you expect from a roller chain, the pins *must* have two characteristics:

One... a case-hardened surface for longest wear life plus a tough, resilient core for shock load resistance.

Two... comparatively soft ends for secure riveting and maximum holding power in the link plates.

How can you have these two opposites in one pin?

In Rex Roller Chains, the pins are completely copper-plated. Then, the copper is ground off only the pin body, leaving the pin ends plated. Next, they're carburized in controlled-atmosphere gas furnaces. Since copper will not absorb carbon during heat treatment, the pin ends are not hardened... remain relatively soft. The pin body gets the file-hard case depth you need.

Look for the *copper-plated pins* before you buy roller chain. They're visible evidence of the *plus* value in Rex Roller Chains. For the story on the "finest roller chains made," mail the coupon. CHAIN Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN Belt Company
4765 W. Greenfield Ave., Milwaukee 1, Wis.
☐ Send me my copy of Catalog No. 610.
☐ Have CHAIN Belt Man call.

Name.....

Company.....

Address.....

City.....*Zone*.....*State*.....

CHAIN BELT

Leadership... through creative engineering

Four more utilities place

CONTROLLED

REPEAT ORDERS

Repeat orders, always the most conclusive indication of user satisfaction, reveal the remarkable acceptance of the C-E Controlled Circulation Boiler. Here are the facts: *All* the companies listed below have placed repeat orders. They represent 65 per cent of all purchasers. Two of the companies have placed seven contracts each and three others, four contracts. The list as a whole averages better than three contracts per company.

Boston Edison Company
Central Hudson Gas & Electric Company
Cincinnati Gas & Electric Company
Cleveland Electric Illuminating Company
Commonwealth Edison Company
Consumers Power Company
Detroit Edison Company
Duke Power Company
Houston Lighting & Power Company
Illinois Power Company
Kansai Electric Power Company
Kansas City Power & Light Company
Kansas Power & Light Company
Niagara Mohawk Power Corporation
Northern Indiana Public Service Company
Pennsylvania Electric Company
Philadelphia Electric Company
Potomac Electric Power Company
Rochester Gas & Electric Corporation
South Carolina Electric & Gas Company
Tennessee Valley Authority
Virginia Electric & Power Company
Wisconsin Electric Power Company

their FIRST ORDERS for

CIRCULATION BOILERS

Five years ago, the Virginia Electric & Power Company initiated a major new trend when it placed in service a C-E Controlled Circulation Boiler.

The rapidity with which this trend has developed is evidenced by the fact that orders for C-E Controlled Circulation Boilers now total *111* units having an aggregate capacity of more than

19,300,000 kw

Recently, the following utility companies have placed their first orders:

	Station	No. of Units	Kw Capacity per unit
Central Illinois Public Service Co.	Meredosia	1	200,000
Consolidated Edison Co. of New York	Astoria	1	340,000
Florida Power & Light Co.	Port Everglades	2	240,000
Pennsylvania Power & Light Co.	(new station)	1	330,000

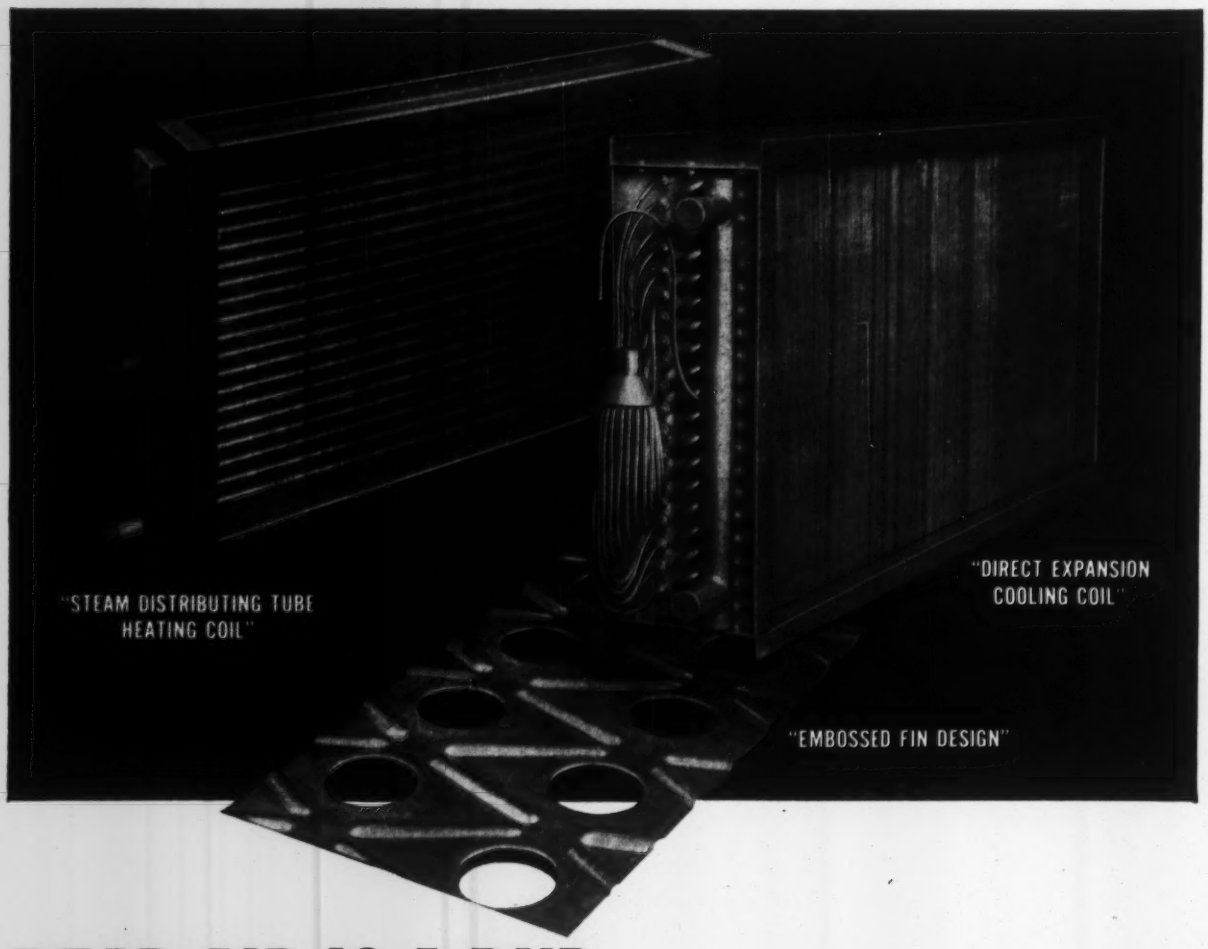
The *repeat order* list opposite reveals the nationwide acceptance of the C-E Controlled Circulation Boiler. The rapidly growing preference for this boiler is the result of its outstanding performance record, particularly with respect to high availability, and the widespread recognition of its special suitability for high pressures. This preference is particularly notable in the 2400-lb pressure range where the C-E Controlled Circulation Boiler leads the field by a wide margin with 36 units installed or on order for a total capacity of 6,600,000 kw.

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N.Y.

C-111

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



DEAD AIR IS A DUD...*and a costly one!*

Dead-air film on smooth fin surface prevents maximum heat transfer!

GET PURCHASED PERFORMANCE! . . . Use Westinghouse Heat Transfer Surface with its air-activating fin design—prevents dead-air film!

All Westinghouse Continuous Plate-fin Coils feature:

- **Embossed Fin design—Maximum Heat Transfer**
- **Permanent Mechanical Bond—Fin to Tube**
- **Minimum Air Resistance**
- **Guaranteed Published Performance**
- **Wide Selection—For Heating and Cooling**

And for Heavy Duty—Industrial-Process and High-Pressure applications . . . standard sections with extra-heavy wrought iron finned pipe!

Call your Sturtevant Division Sales Engineer for complete details on your heating and cooling coil requirements, or write Westinghouse Electric Corporation, Department K-14, Hyde Park, Boston 36, Massachusetts.

J-80635

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

Oxygen from the air puts on weight
...thousands of tons a day

Oxygen—part of the air you breathe—is so light you can weigh it only with the most delicate of balances. A whole roomful tips the scale at just a few pounds.

Yet, oxygen is so essential to the nation's economy that LINDE produces it by the thousands of tons. In a small flask or cylinder . . . in large cylinders . . . in tank trucks or railroad tank cars . . . or in tonnage quantities through pipelines—LINDE delivers oxygen, as a gas or as a liquid, in whatever quantity that may be required. A welding repair shop may need only one cylinder—hospitals, large banks of cylinders for hundreds of patients. Portable units, too, are supplied for therapy in your doctor's office, or in your home.

For tonnage users—steelmakers, chemical processors, defense industries—LINDE builds oxygen-producing plants right where needed. Such on-site facilities, capable of supplying a few or thousands of tons each—*with no capital investment by the user and at a price guaranteed by* LINDE—are producing thousands of tons of oxygen daily for the requirements of industry.

If you use oxygen . . . or acetylene, nitrogen, argon, the rare gases . . . contact LINDE. Our continuing expansion program is part and parcel of LINDE's 50-year-old policy of providing dependable service.

LINDE COMPANY, Division of Union Carbide Corporation, 30 E. 42nd St., N. Y. 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

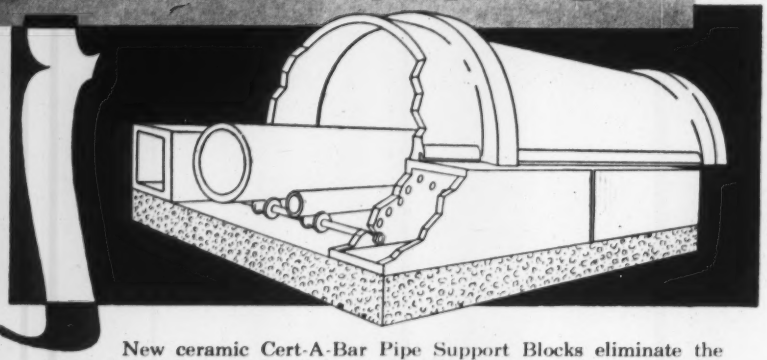
The steel industry uses LINDE oxygen in electric furnaces, to improve the quality and speed the production of stainless steels.

Linde

UNION CARBIDE

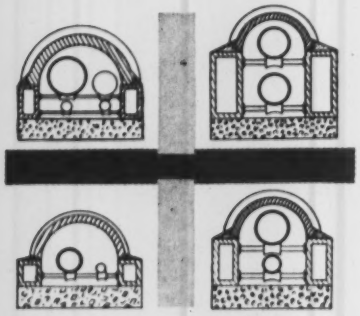
PERMANENT PROTECTION
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

WRITE FOR

illustrated, four-page circular with complete installation specifications.

*T.M. Reg. App. For. Patents Pending

The Stillwater Clay Products Co.
STILLWATER CONDUIT DIVISION

STILLWATER CONDUIT SYSTEMS

NEW

FAIRBANKS-MORSE

INTEGRAL HP

SINGLE PHASE

CAPACITOR

MOTORS

Newest addition to the F-M line of improved electrical equipment, single-phase capacitor-start motors are designed for severe applications.

New drip-proof frame and bearing arms are rigid, durable, corrosion-resistant. No pressed steel or sheet aluminum in any structural part. Famous F-M Copperspun rotor with shaft, fans and centrifugal switching mechanism dynamically balanced as a unit for smooth, vibrationless operation.

Starting capacitors are designed for maximum starting torque . . . minimum starting current. Rugged, trouble-free centrifugal switch features oversized snap-action contacts.

New Bulletin 2401 giving complete details will bring you up to date on the newest in capacitor-start, induction-run motors. Write: Fairbanks, Morse & Co., Dept. ME-10, Chicago 5, Illinois.

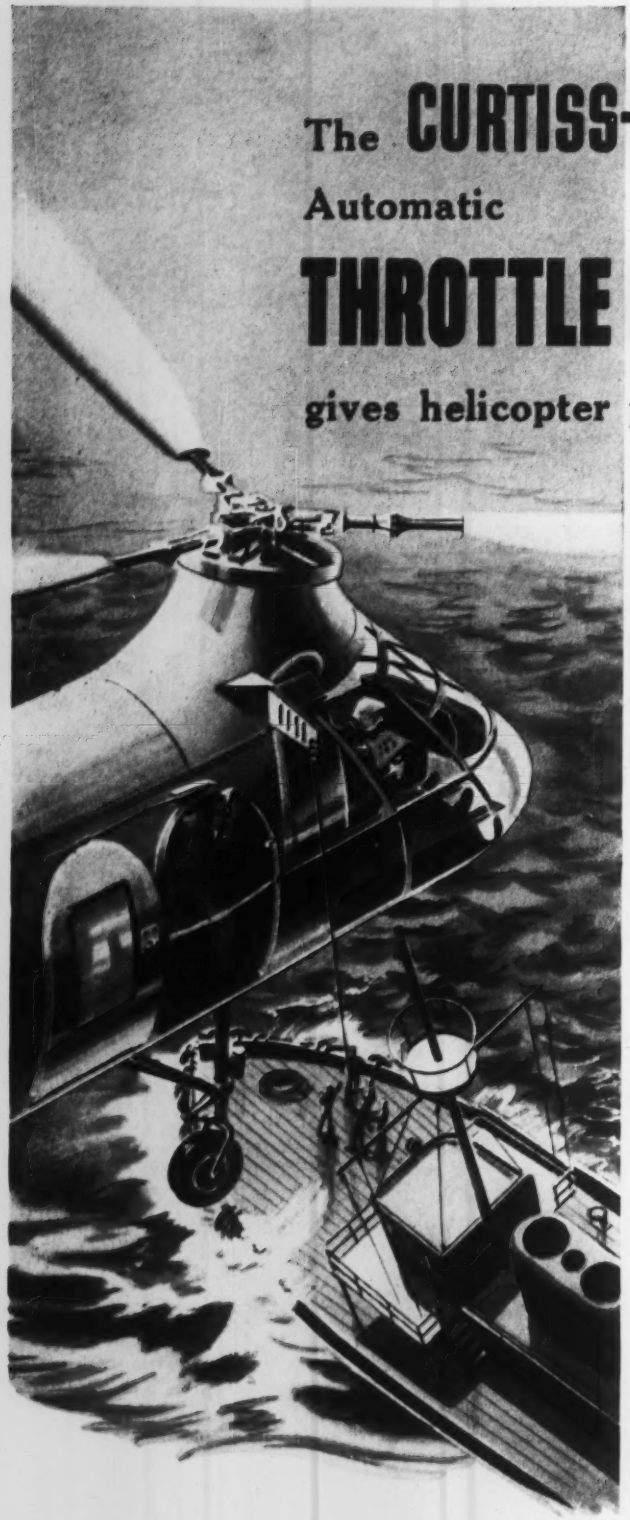
FAIRBANKS-MORSE

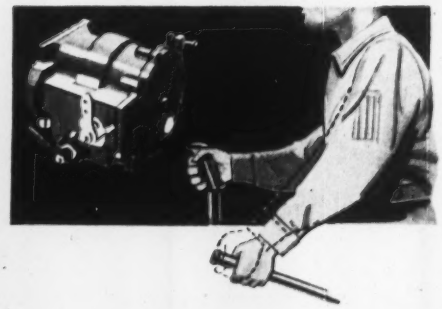
a name worth remembering when you want the BEST

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

The CURTISS-WRIGHT Automatic THROTTLE CONTROL

gives helicopter pilots a "Third Hand"





Many times a helicopter pilot wishes he had three hands . . . one to govern direction, another to control the up, down or hover movement, and a third to regulate the throttle. Now, Curtiss-Wright, in cooperation with the U. S. Army and the U. S. Navy, answers this need for a "third hand" with the all-mechanical Automatic Throttle Control.

It makes the pilot's job much easier. He simply sets the desired engine speed with the regular twist-grip throttle . . . the Automatic Throttle Control takes over and keeps engine speed constant, automatically adjusting fuel flow to meet changing conditions.

The Automatic Throttle Control adds immeasurably to the safety and utility of helicopters . . . safeguards engine against overspeed. Planned for use in airships and other throttle-governing applications, it is one more example of the many cooperative contributions by Curtiss-Wright to America's leadership in air transportation.

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CURTISS-WRIGHT
CORPORATION • CALDWELL, N. J.

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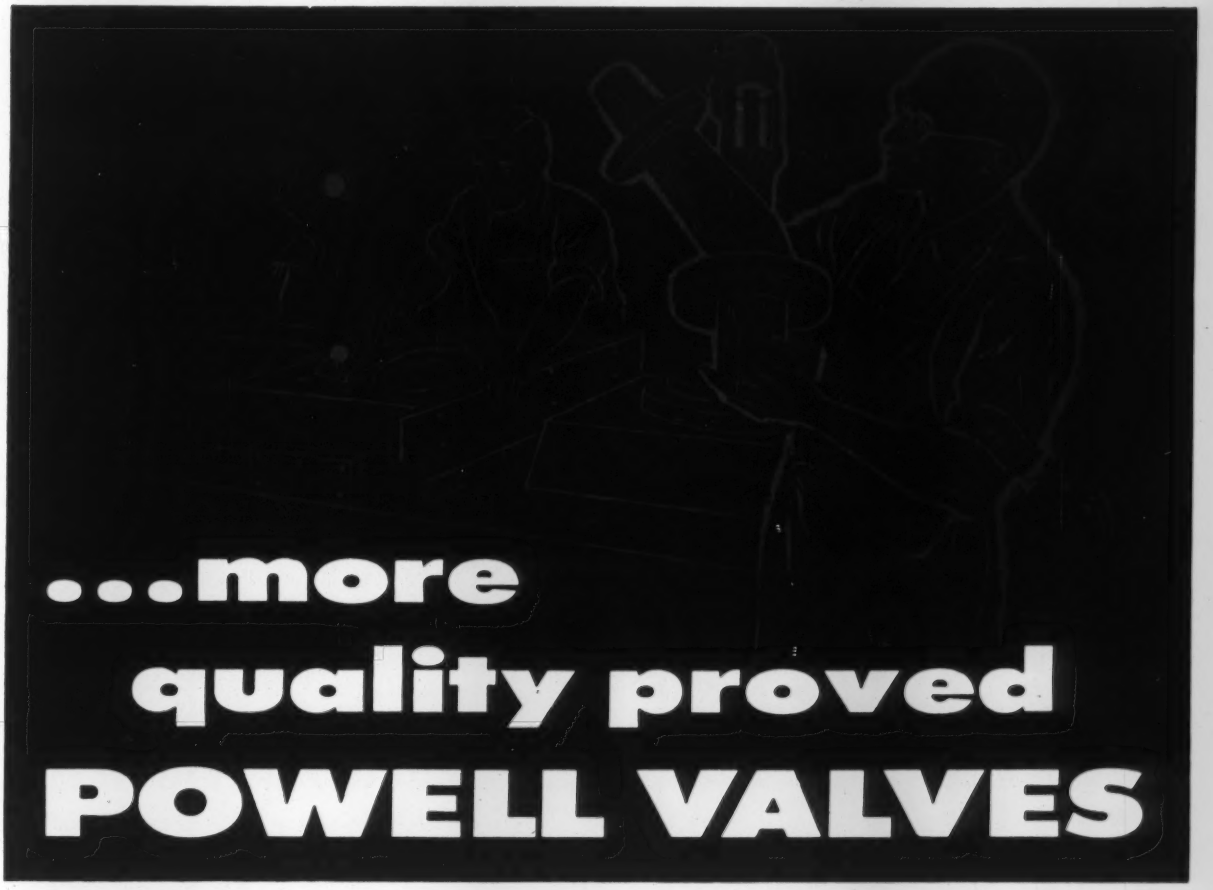


...more quality proved POWELL VALVES

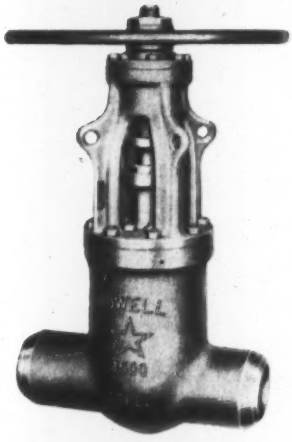


Fig. 11303—1500-Pound Cast Steel Pressure Seal Gate Valve.

Fig. 375—Bronze Gate Valve for 200 Pounds W.S.P. Union Bonnet. Inside Screw Rising Stem.

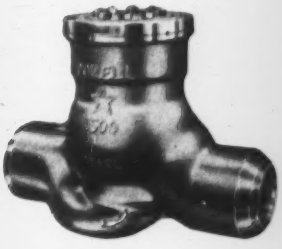


Fig. 11365—Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

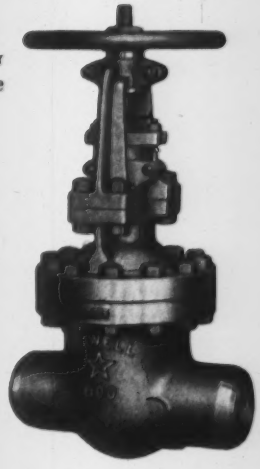


Fig. 6003-WE—Steel Gate Valve for 600 Pounds. Welding Ends. Outside Screw Rising Stem and Yoke.

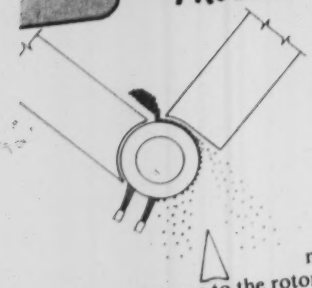
for quality-crafted flow control

Ask your Powell Valve Distributor for the facts about quality-proved bronze, iron, steel and corrosion-resistant valves. Whatever your flow control problem, there's a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

from the Variac® Case Book

PROBLEM:



To achieve accurate and reliable means for the control of the magnetic field and rotor speed of a mineral separator system.

The system: A heterogeneous mixture of minerals is hopper-fed onto a magnetized rotor. The magnetic material adheres to the rotor and is brushed off into a bin. The non-magnetic portion does not adhere and falls through the system into another bin.

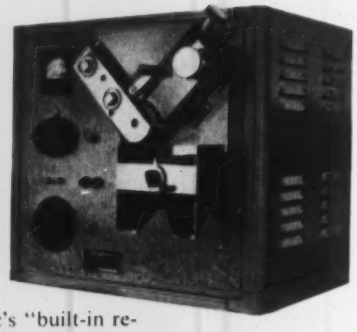
The controls for this system must be capable of regulating the magnetic field and/or the rotor speed so that materials of varying magnetic behavior are readily separated. The controls must operate efficiently and give clean separation at high feed rates even for materials with very low magnetic susceptibilities.

SOLUTION:

Two Type W5 Variac autotransformers are now used in the separator. One is used to control the magnetic flux, the other is used as the rotor speed control. Their smooth, stepless control and good voltage regulation assure positive adjustment. Rugged Variac construction (will withstand MIL-T-945A shock and vibration tests) insures long life and consistent, dependable service. A silver-plated brush track (Duratrak) gives the Variac additional "life insurance."

Variacs can be easily designed into equipment. They can be panel, behind-panel, wall, or table mounted. Square-cut bases of drawn aluminum alloy give Variacs added strength and mounting convenience.

RESULT:



Carpco Manufacturing, Inc. of Jacksonville, Florida, uses Variacs in their laboratory model magnetic separator. Designed for mineralogical assay and research work on small samples, it may also be used for production control and development. This separator is another example of how the Variac's "built-in reliability" aids manufacturers in designing equipment for long, trouble-free service.

Special Designs
Portable Models
350 to 1200 cycle Models
Cased Models
Motor-Driven Model
Ganged Models
Three-Phase Models

other Variac® models are available with current ratings from 2.4 to 50 amperes — at prices ranging from $13.50 to $120. They may be ganged for additional capacity or polyphase operation.

Write for Complete Information

GENERAL RADIO Company

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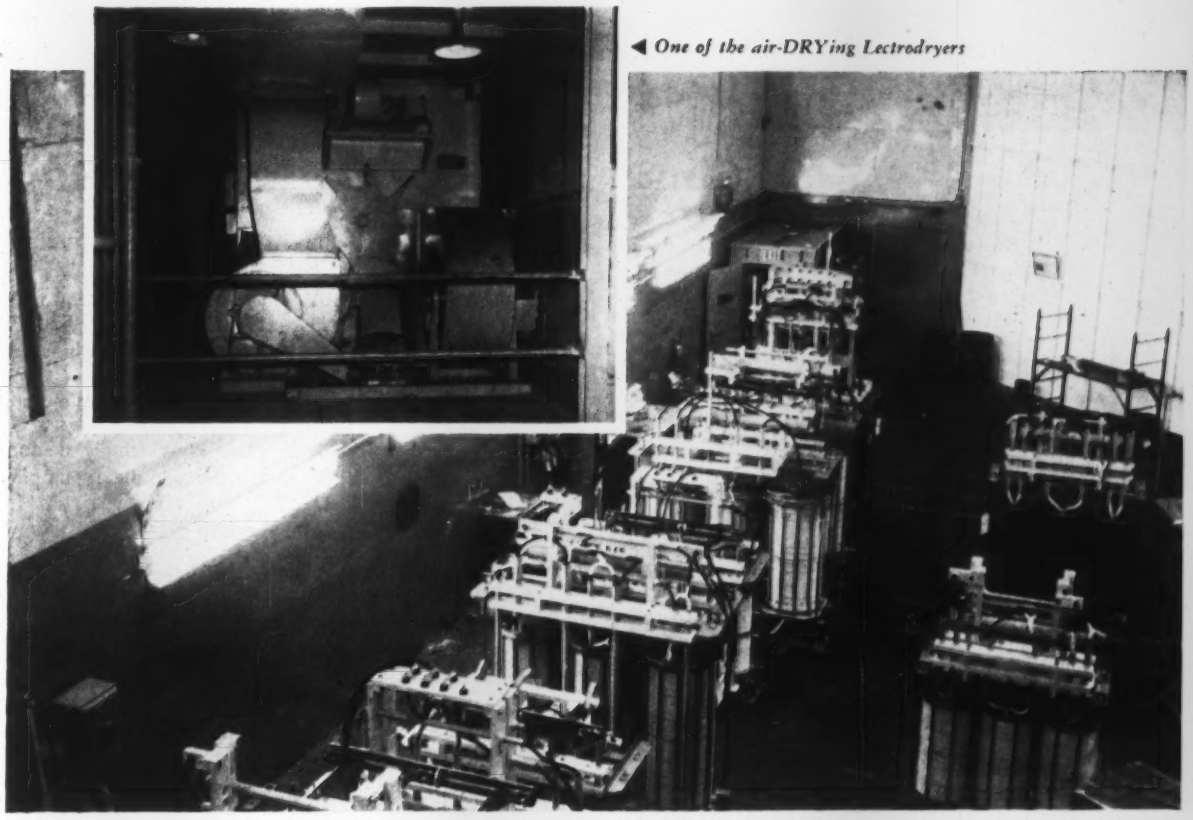
Like all G-R Instruments, Variacs are covered by a

2-Year Warranty



◀ *One of the air-DRYing Lectrodryers*

*This 210,000 cubic foot area is served by four Lectrodryers**

Transformers are held in DRY room awaiting assembly

500 to 7,500 KVA transformers built by General Electric Company at Rome, Georgia, are given the vapor phase treatment before assembly. Cores and coils are heated in a vacuum, sprayed with hot oil to seal against moisture infiltration, then placed in this DRY room.

Four Lectrodryers hold this huge area between 3% and 11% relative humidity. Although automatically controlled, as an added precaution, an alarm is set to sound if the moisture level rises above 8%.

In dozens of industries, Lectrodryers are contributing to quality and speed of production—DRYing air, gases and organic liquids. Installations are pictured in the booklet, *Because Moisture Isn't Pink*. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S.A. Stein & Roubaix, 320 Rue du Moulin, Bressoux-Liege.

Lectrodryer

*REGISTERED TRADEMARK U.S. PAT. OFF.

BIG CITY • BIG DEMAND

BIG RIVER Solution: Big Pumps

Capacity 50,000,000 gallons a day

Installed for ST. LOUIS COUNTY WATER COMPANY, NORTH END PLANT, ST. LOUIS, MISSOURI

Intake Pumps: 4 - 150 hp Peerless 36" single-stage vertical turbine pumps.

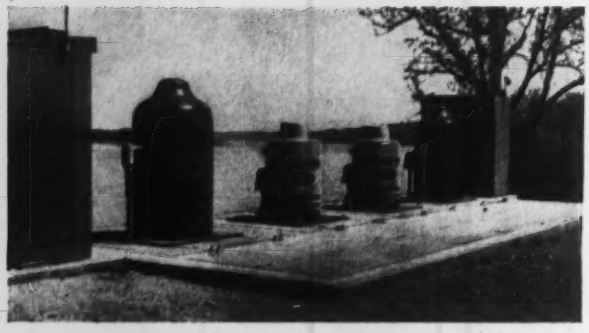
Booster Pumps: 8 - 500 hp Peerless 22" single-stage horizontal double-suction pumps.

Here's another installation that convincingly demonstrates Peerless' ability to do the complete pumping job efficiently:

vertical pumps for **water supply**
horizontal pumps for **water pressure**

Either way you look at a pumping job—towards horizontals or towards verticals—follow the lead of consulting and water works engineers everywhere. Select Peerless horizontal and vertical pumps from one of the most complete lines of high quality, water handling pumps offered by any manufacturer.

Remember: Peerless builds dependable pumps for *all* water handling services—supplying, circulating, dewatering, drainage and flood control protection—and for all applications—municipal, industrial, commercial and domestic.



BIG VERTICALS—The middle 2 of these 36" single-stage Peerless vertical intake pumps are driven by 150 hp induction motors. The other 2 pumps (same specifications) are driven by wound rotor motors.

BIG HORIZONTALS—These 8 Peerless horizontal single-stage, double-suction pumps are driven by 500 hp motors. Mounted in series, these 22", high service pumps maintain pressure at required standard.

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, Calif.

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; San Francisco; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
Distributors in Principal Cities.
Consult your Telephone Directory.

PLEASE SEND PUMP BULLETINS DESCRIBING

☐ Peerless Horizontal Pumps (Bulletin B-1300) ☐ Peerless Vertical Pumps (Bulletin B-505)

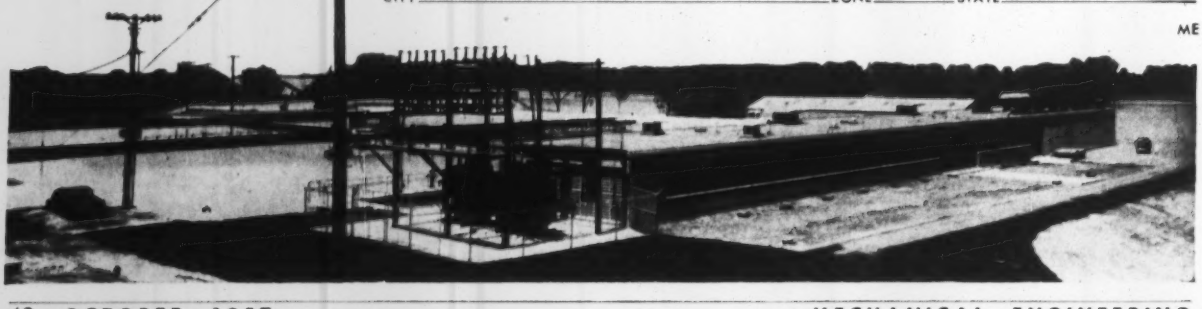
NAME _____

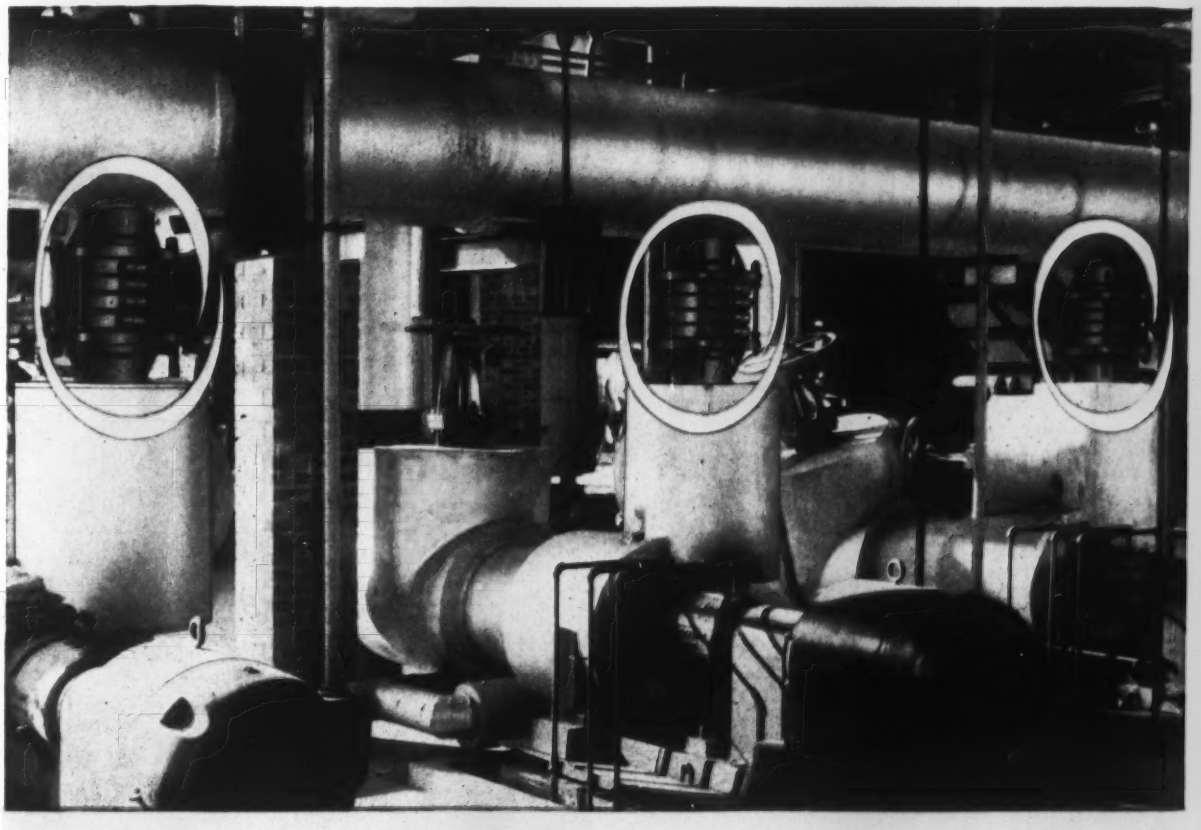
ADDRESS _____

CITY _____ ZONE _____ STATE _____

ME

BIG PLANT—View of the North End Plant, St. Louis County Water Company. A model of planning and efficiency, this is one of the nation's "show place" filtration stations.





ADSCO CORRUFLEX EXPANSION JOINTS SOLVED A PIPING PROBLEM FOR NATIONAL ANILINE

The new $20,000,000 diisocyanates plant of the National Aniline Division, Allied Chemical & Dye Corp., at Moundsville, W.Va., is known for many engineering wonders, especially its miles of intricate piping. The photo above shows three ADSCO Corruflex anti-compression packless expansion joints used to secure satisfactory piping connections between the main piping and three pumps.

If rigid piping had been used to connect the three pumps to the 18-inch main feeder, the piping soon would have been twisted and overstressed by the growth of the main feeder when hot process liquid was pumped through it. National Aniline engineers, in consultation with ADSCO engineers, decided to use the anti-compression joints shown in the photo. These are deflected laterally with minimum strain on the connecting piping and pumps as the main feeder expands or contracts. Also, the joints absorb vibration of the pumps and motors.

For efficient, right-working pipe line arrangements, use ADSCO Corruflex expansion joints. Packless, they require no maintenance. Sizes, 3" to 54"; for temperatures to 1600 F and pressures to 300 psi.

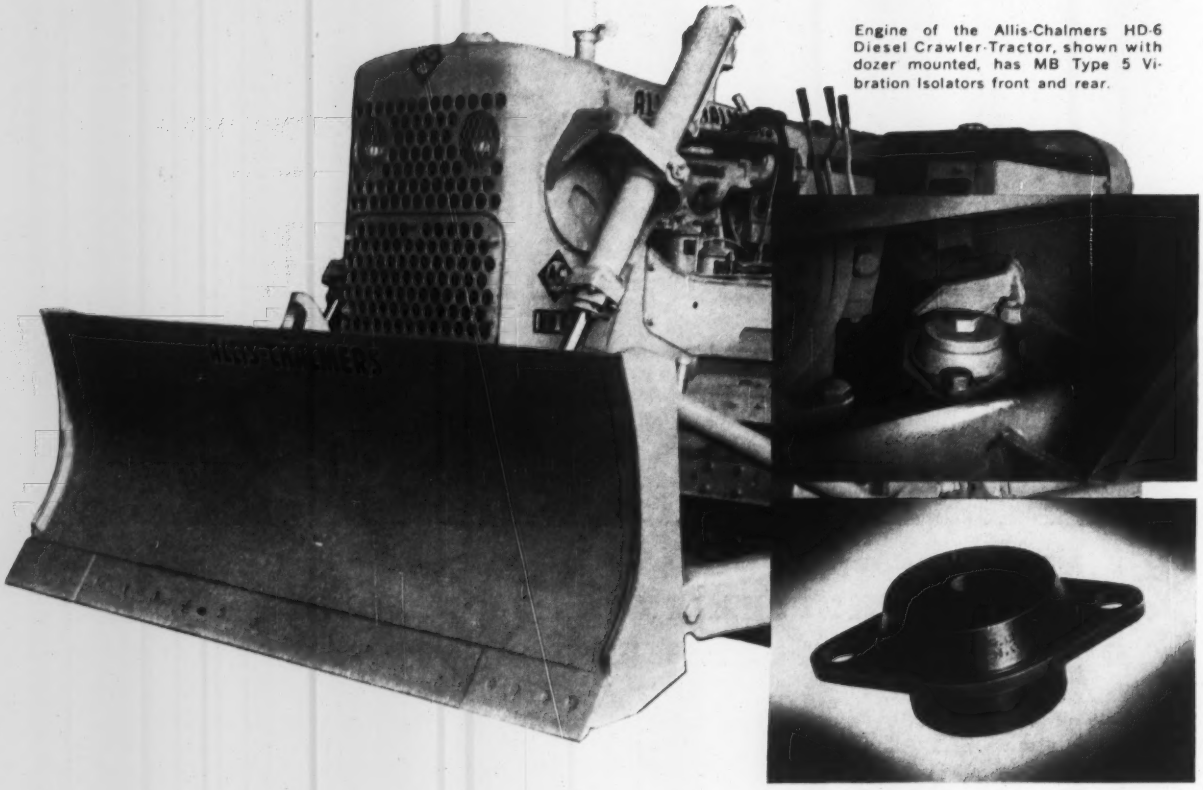
REMEMBER! Use ADSCO Expansion Joints instead of Pipe Bends because of these advantages:

1. Less Heat Loss 2. Less Pressure Drop 3. Less Space 4. Less Cost

ADSCO DIVISION
20 MILBURN STREET
BUFFALO 12, NEW YORK

YUBA
CONSOLIDATED INDUSTRIES, INC.

MB engine mounts work even in dozer service



Engine of the Allis-Chalmers HD-6 Diesel Crawler-Tractor, shown with dozer mounted, has MB Type 5 Vibration Isolators front and rear.

THE Allis-Chalmers Model HD-6 crawler tractor has the distinction of being one of the first tractor dozers having successful isolation of engine. Many an operator of the dozer can thank use of a main frame and Isomode® Type 5 Mounts for the improvement.

Why is this application so hard on a mount? Obviously, the mount must be capable of surviving severe shock. It has pitching tortuous motions to endure. It is subjected to distortion, to bursts of power and high engine torque.

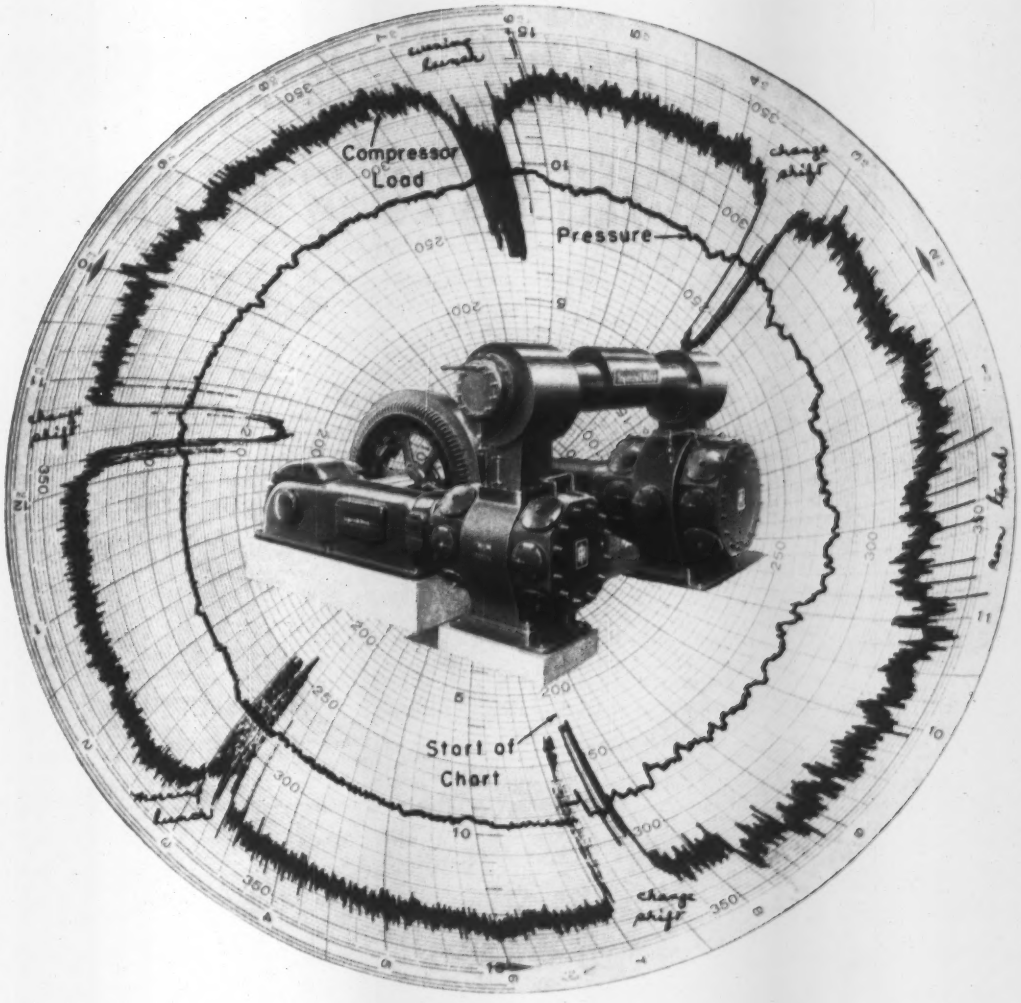
The MB Type 5 Mount performs to a principle developed by MB specialists over 10 years ago. It has an equal spring rate in all directions, thus equally isolating the six possible modes of vibratory motion. With its core in balanced compression and shear, it offers high load capacity and endurance in compact size; and is safely self-snubbing to control damaging overloads.

MB concentrates on mounts which start where ordinary units have to give up. While *standard* units are available, MB mounts are actually in the *special performance* class. Perhaps we can work out a modification of one to solve *your* troublesome vibration problem. Send for Bulletin 616A. ® *registered trademark.*

MB manufacturing company 1074 State Street New Haven 11, Conn.

A Division of Textron Inc.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION...TO EXCITE IT...TO MEASURE IT.



AROUND THE CLOCK

with an Ingersoll-Rand PRE Compressor

Heavy 24-hour loading like this is all in a day's work at Caterpillar Tractor Co.

An air compressor doesn't punch a time clock. But the 24-hour pressure-capacity chart shown above gives an even better record of its actual, on-the-job performance at Caterpillar Tractor Co., Peoria, Ill.

This chart was taken on a nine-year-old PRE compressor supplying 3330 cfm at 95 psi for general plant air. Except for a slight "breather" during changing of shifts, this heavy-duty compressor is called upon to deliver full rated capacity virtually 24 hours a day — month after month, year after year.

This compressor is one of eight PREs (total capacity 24,640 cfm) in round-the-clock service at the Caterpillar plant. The first PRE unit was installed here in 1927 and, like all the rest, is still giving efficient, dependable performance under full load conditions.

For proved dependability like this, in continuous heavy-duty service, it pays to specify Ingersoll-Rand compressors. Ask your I-R representative to give you the complete story.

PRE compressors, 400 to 3000 hp, use I-R Channel Valves

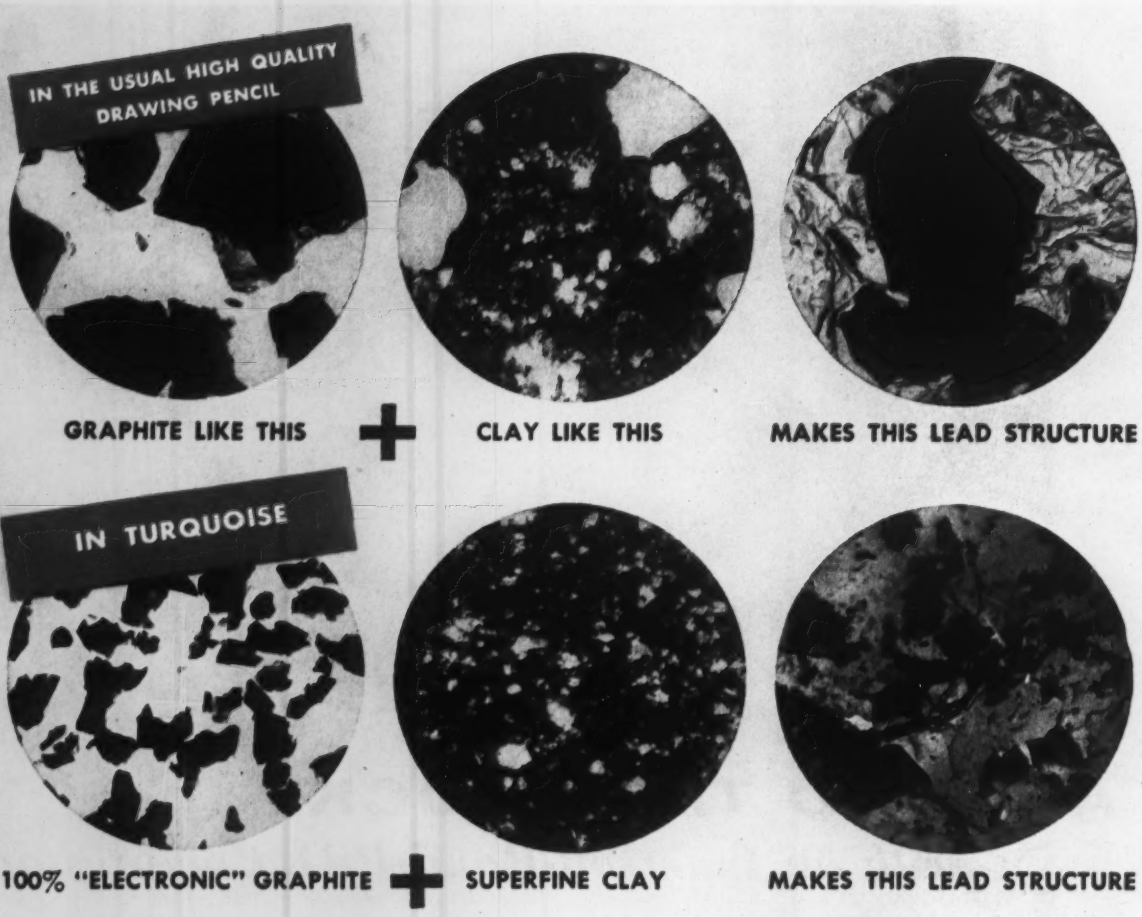
I-567

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS AND DIESEL ENGINES • ROCK DRILLS • PUMPS • TURBO-BLOWERS • AIR AND ELECTRIC TOOLS

Now you, and your customers can **see** why only leads & pencils give you perfect



YOU ALWAYS GET PROVEN QUALITY FROM TURQUOISE DRAWING LEADS AND PENCILS

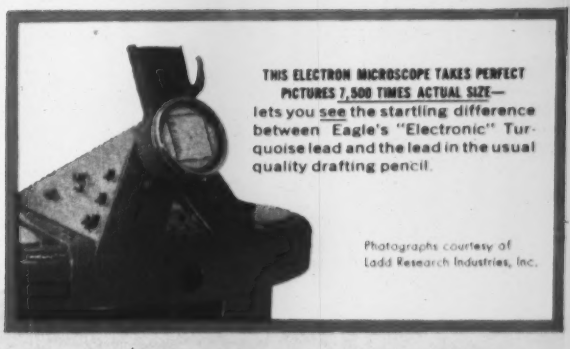
PROVEN GRADING - 17 different formulae make sure you get exactly the line you expect—from every pencil, every time.

PROVEN DURABILITY—Because compact lead structure gives off no chunks of useless "dust" to blow away, Turquoise wears down more slowly.

PROVEN NEEDLE-POINT STRENGTH—as electron photomicrograph shows, Turquoise lead structure is finer—and therefore stronger. It holds a needle point under drawing pressures for long lines of unchanging width.

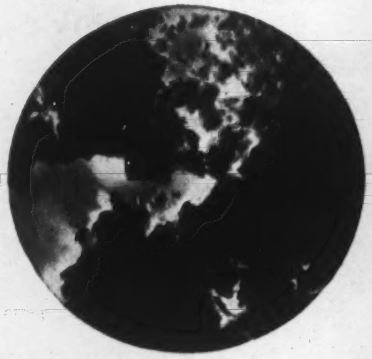
EAGLE PENCIL COMPANY • NEW YORK • LONDON • TORONTO • MEXICO • SYDNEY • BOGOTA

Eagle Turquoise reproduction



THIS ELECTRON MICROSCOPE TAKES PERFECT PICTURES 7,500 TIMES ACTUAL SIZE— lets you see the startling difference between Eagle's "Electronic" Turquoise lead and the lead in the usual quality drafting pencil.

Photographs courtesy of Ladd Research Industries, Inc.



...AND MARKS LIKE THIS

Relatively large, irregular particles of graphite make a rough-edged line with gaps that permit the passage of light. Prints will be inferior.

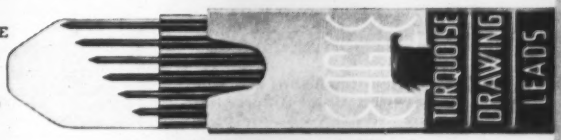
...AND MARKS LIKE THIS

Tiny, more uniform particles deposit as a clean-edged, solid opaque line that blocks the light and reproduces to perfection.

WRITE FOR FREE SAMPLE DEMONSTRATION KIT
(including Turquoise wood pencil, Turquoise lead, and Turquoise "skeleton" lead) naming this magazine. Eagle Pencil Company, 703 East 13th Street, New York, N. Y.

• TURQUOISE DRAWING PENCILS: 9 "Electronic" graphite. 17 grades, 6B through 9H.

• TURQUOISE CLEANTEX ERASER: Super-soft, non-abrasive rubber.



• TURQUOISE DRAWING LEADS: Fit any standard lead holder. Grades 5B through 9H.

• TURQUOISE LEAD HOLDERS: Hold any grade of Turquoise lead.

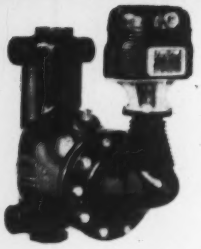
EAGLE® TURQUOISE®
PENCILS AND LEADS
are the largest-selling in the United States!

For jobs like these...

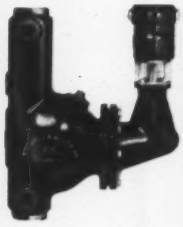
Choose from this McDONNELL Line-up

- Boiler Feed Pump Control
- Low Water Fuel Cut-off Switch
- Low Water Alarm Switch
- High Water Alarm Switch
- Electric Valve Control
- High and Low Level Tank Control

No. 92—For any size boilers or tanks with pressures up to 250 psi. Installed with top and bottom equalizing piping. Used on boilers equipped with separate water column.

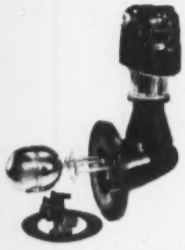


No. 192—For fire-tube boilers with pressures up to 250 psi. Has integral water column for gauge glass and try-cock trim. Holds minimum efficient water level.



No. 292—For water-tube or high set boilers where more visible water in gauge glass is desired. Has integral water column. For pressures to 250 psi.

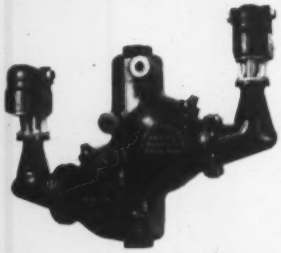
No. 92A—Has lower side equalizing connection. Same features as all 92 Series: operating levels easily adjusted, ample float clearance, low switch terminal temperature, etc.



No. 92-HD—For flange mounting on tanks or water columns. For pressures up to 250 psi. No. 91-HD also available for pressures up to 150 psi.

No. 91—For any size boilers or tanks with pressures up to 150 psi. Used on boilers equipped with separate water column. Same repulsion magnetic switching for positive operation.

No. 191—For boilers up to 150 psi. Integral water column. All 91 and 92 Series controls have two single-pole double-throw switches. Ideal for motor operated valve control.



No. 291—For applications requiring very wide operating differentials. Pressures to 150 psi. Commonly used with duplex pumping arrangements.

Write for Bulletin L-123

Has the whole story of the McDonnell 92 and 91 Series controls in a boiled-down usable form. Contains service recommendations, installation drawings, wiring diagrams, etc.

Underwriters Listed • C.S.A. Approval No. 5545.

McDonnell & Miller, Inc., 3510 N. Spaulding Ave., Chicago 18, Illinois

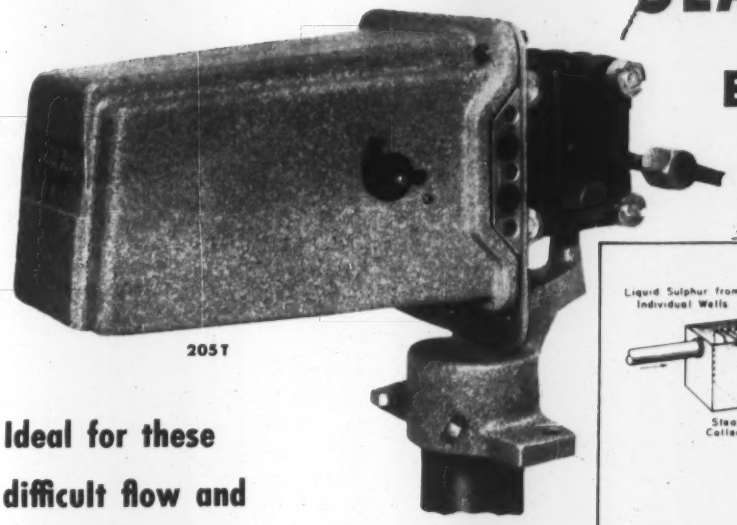
Your Jobber Stocks Them

Doing One Thing Well

McDONNELL Boiler Water Level Controls and Safety Devices

New Taylor Volumetric Differential Pressure Transmitter

. . . ELIMINATES ~~PURGE~~ AND ~~SEAL~~ PROBLEMS ECONOMICALLY!



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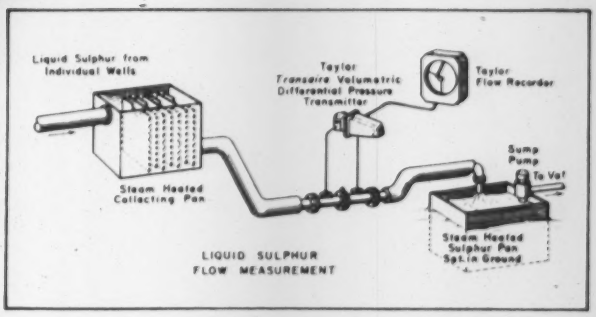

Liquid Sulphur from Individual Wells
Taylor Transaire Volumetric Differential Pressure Transmitter
Taylor Flow Recorder
Sump Pump
To Vat
Steam Heated Collecting Pan
Steam Heated Sulphur Pan Set in Ground
LIQUID SULPHUR FLOW MEASUREMENT

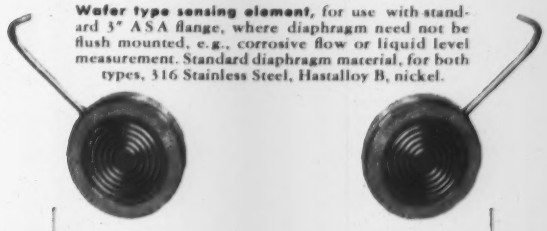
Ideal for these difficult flow and liquid level measurements:

- Slurries
- Corrosive liquids
- Colloidal suspensions
- Fluids that jell when not in motion

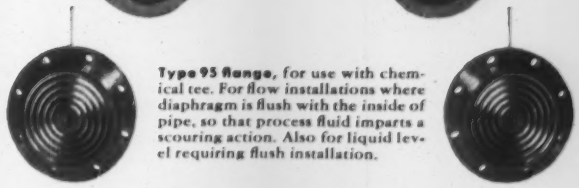
The new Taylor Volumetric Differential Pressure Transmitter is completely isolated from the process material. Thus it never has to be purged of deposited material, never suffers from corrosion. The pressure-sensitive diaphragms may be installed flush with the inside of the pipe or tank in a variety of mountings. The temperature limit is 300° F. at the diaphragms. Pressure limit of the instrument is 1500 lbs., and the system is limited only by the flange rating on the primary side.

This instrument is a modification of the familiar Taylor 333RD differential pressure transmitter, and is just as accurate, sturdy and dependable.

For full details about this new instrument, ask your Taylor Field Engineer, or write for **Bulletin 98281.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



Wafer type sensing element, for use with standard 3" ASA flange, where diaphragm need not be flush mounted, e.g., corrosive flow or liquid level measurement. Standard diaphragm material, for both types, 316 Stainless Steel, Hastalloy B, nickel.



Type 95 flange, for use with chemical tee. For flow installations where diaphragm is flush with the inside of pipe, so that process fluid imparts a scouring action. Also for liquid level requiring flush installation.

Taylor Instruments

MEAN

ACCURACY, FIRST

VISION · INGENUITY · DEPENDABILITY

T F

TAYLOR

Welding nozzles

T.E.M.A. flanges and channels

Multiple outlet headers

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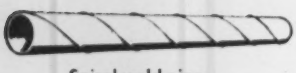
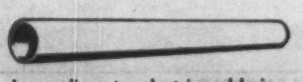
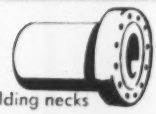


Spiral weld pipe



Large diameter electric weld pipe



Welding necks

For utmost value

FORGE Welding Fittings and Forged Flanges

Whether it's a "heavyweight", like the big special wall thickness WeldELL pictured here, or a Schedule 5S Stainless Steel "lightweight"—in fact *any* thickness, size or type of Welding Fitting or Forged Flange—you can be sure of utmost value if it's made by Taylor Forge.

In 57 years of specialized forging experience we've learned how to make metals do precisely what we want them to do . . . how to form them to exact dimensions . . . how to control grain flow so as to put extra strength where it is needed . . . how to maintain great accuracy and finest quality in everything we make from the smallest to the largest unit.

All of this is just another way of emphasizing the fact that Taylor Forge Welding Fittings and Forged Flanges can be depended upon to meet your most exacting requirements . . . to provide utmost value.

So . . . remember . . . for everything in Welding Fittings and Forged Flanges . . . every size, type, thickness or pressure rating . . . every forgeable material . . . it pays to turn to Taylor Forge . . .

TRADITIONALLY DEPENDABLE

For prompt, efficient and reliable service, patronize your local Taylor Forge Distributor.

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ALL IN A DAY'S WORK at *Pittsburgh Piping*

These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

Promoting Progress **IN POWER AND PROCESS PIPING**

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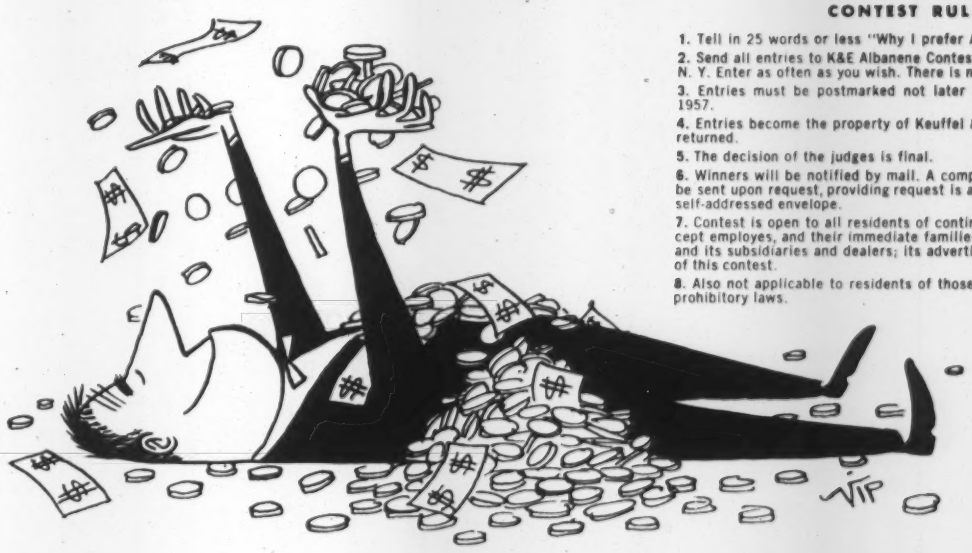
		Toronto	*68 Yonge Street*

ENTER THIS CONTEST ...90 CASH PRIZES!



CONTEST RULES

1. Tell in 25 words or less "Why I prefer Albanene tracing paper."
2. Send all entries to K&E Albanene Contest, Box 160, New York 46, N. Y. Enter as often as you wish. There is nothing to buy.
3. Entries must be postmarked not later than midnight, Nov. 30, 1957.
4. Entries become the property of Keuffel & Esser Co. None can be returned.
5. The decision of the judges is final.
6. Winners will be notified by mail. A complete list of winners will be sent upon request, providing request is accompanied by stamped, self-addressed envelope.
7. Contest is open to all residents of continental United States, except employes, and their immediate families, of Keuffel & Esser Co. and its subsidiaries and dealers; its advertising agency; and judges of this contest.
8. Also not applicable to residents of those states where there are prohibitory laws.

Why I prefer **ALBANENE**® Tracing Paper...

First prize **$1500**
Second prize **$1000**
Third prize . . . . . **$ 500**

plus 87 prizes of $25 each!

In 25 words or less, tell us why you prefer K&E Albanene® tracing paper. Your reasons may win one of these 90 prizes (it's K&E's 90th anniversary).

Here's a hint: Albanene is made from 100% rag stock for superlative tear strength. It is permanently transparentized with an inert resin. Draftsmen like it because of its easy drawing qualities . . . reproduction men for its high transparency and permanence. Everybody likes it because "what you pay for stays in the paper." That's why Albanene is the best seller among *all* tracing papers.

Get contest aids from your K&E dealer: Information booklets, extra contest entry blanks, samples of Albanene, too, if you need them. You can enter as often as you please.

Or use a plain sheet of paper if someone's already snipped the blank below. Give your name, address, and firm name, twenty-five words or less telling why you prefer Albanene tracing paper, and mail to K&E Albanene Contest, Box 160, New York 46, N. Y. before midnight, November 30, 1957.

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K & E Albanene Contest, Box 160, New York 46, N. Y.

Here's why I prefer Albanene Tracing Papers_____

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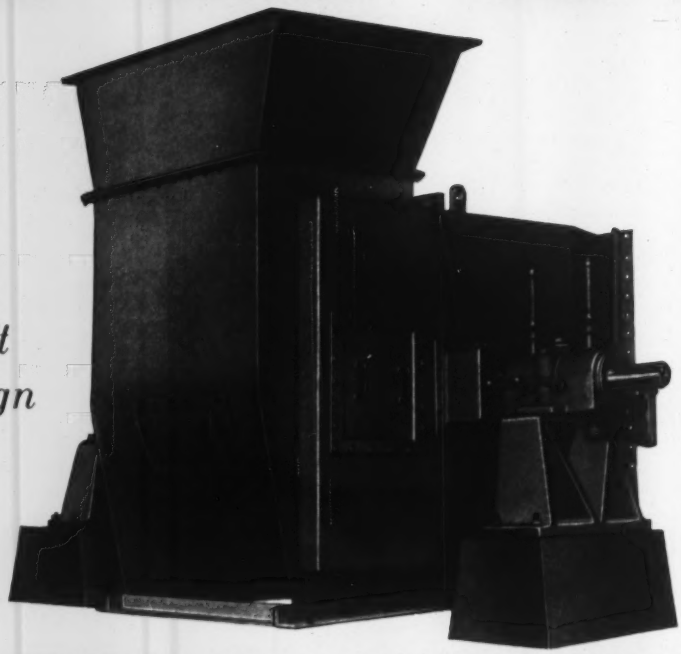
NEW

Introducing a unique concept of induced draft equipment design



CLARAGE TYPE DN DYNACURVE FANS

You'll find this new Clarage product has many advantages in store for you. For example: Minimum floor space and height requirements . . . Low first cost, installation cost, and operating cost . . . High efficiency over a wide performance range . . . Fan wheel built with 36 aerodynamically curved blades and tapered rims . . . Exceptionally rugged construction fully equal to the most exacting assignments. Obtain full information on Type DN Dynacurve Fans. Write today for Catalog 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

This Bailey Meter Control System is —

Saving Fuel at Appliance Park

★ General Electric Company at its Appliance Park Boiler House, Louisville, Ky. has found that Bailey Controls help to save fuel by continuously maintaining desired operating conditions.

With a Bailey-engineered control system you can count on a high output of available energy per unit of fuel.

Here's why:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record.

A128-1

FORMULA
for Cutting Steam Costs

\+ Bailey Design
\+ Bailey Engineering
\+ Bailey Service

= Greater Savings per Fuel Dollar

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METER COMPANY
1026 IVANHOE ROAD
CLEVELAND 10, OHIO

Complete Controls for Steam Plants

BAILEY METERS

Controls for

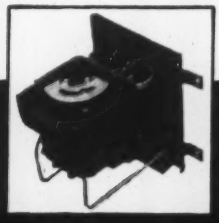
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

REPUBLIC'S new family of

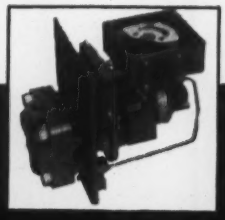
NULL-BALANCE-VECTOR*

PNEUMATIC

INSTRUMENTS

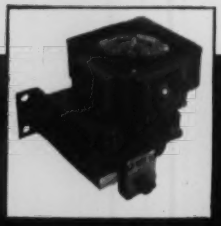


TYPE VP
Pressure Transmitter
Standard Ranges
0-1.5" to 0-5000 psi



TYPE VDP
Differential Transmitter
Standard Range
0-15 to 0-300" H_2O

TYPE VT
Temperature Transmitters
Standard Range
0-100° to 0-1000 F.



TYPE VC
Control Transmitters

*
Design principle which permits making extremely accurate and sensitive components that are compact, versatile and interchangeable.

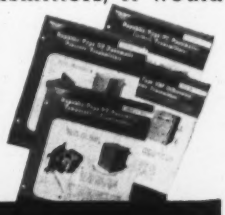
Republic's new line of pneumatic instruments includes pressure, differential pressure, temperature and control transmitters. Controllers that feature repeatable reset rate, less than 0.05% dead band and proportional band adjustment from 2 to 500%;—differential pressure transmitters with 20 to 1 range adjustment;—pressure transmitters of ±0.5% accuracy; and temperature transmitters with 10 to 1 range adjustment show the flexibility as well as the compactness, lightweight and accessibility of these instruments.

THE NULL-BALANCE-VECTOR PRINCIPLE

In terms of calibration, the null-balance-vector principle means that the span of any pneumatic instrument in the line can be varied at will . . . merely use a screwdriver and a reference . . . without re-setting zero. In terms of theory, the null-balance-vector principle means that the proportion of an input force (from a measuring bellows, bourdon tube, diaphragm, etc.) balanced by the pneumatic circuit can be varied by changing the angle at which that force acts on other links in the system. Hence, without changing air supply pressure or the measuring bellows, bourdon tube or diaphragm, the same output signal pressure range can reflect a measured input signal range that can be changed as much as 20-to-1.

Republic's new family of pneumatic instruments was developed in parallel programs that use the greatest possible number of common components. The result: High interchangeability of parts, even between instruments performing entirely different functions. Such design foresight has made the spare parts and training problems extremely simple. And Republic's null-balance-vector design means that full-range operation involves virtually no motion . . . and virtually no wear.

If you want the best sensitivity, accuracy and reliability in pneumatic transmitters, it would pay you to get full details on all four of Republic's new family of Null-Balance-Vector Pneumatic Instruments. Write for descriptive folios on each type, now.



REPUBLIC FLOW METERS CO.
A Subsidiary of Rockwell Manufacturing Company
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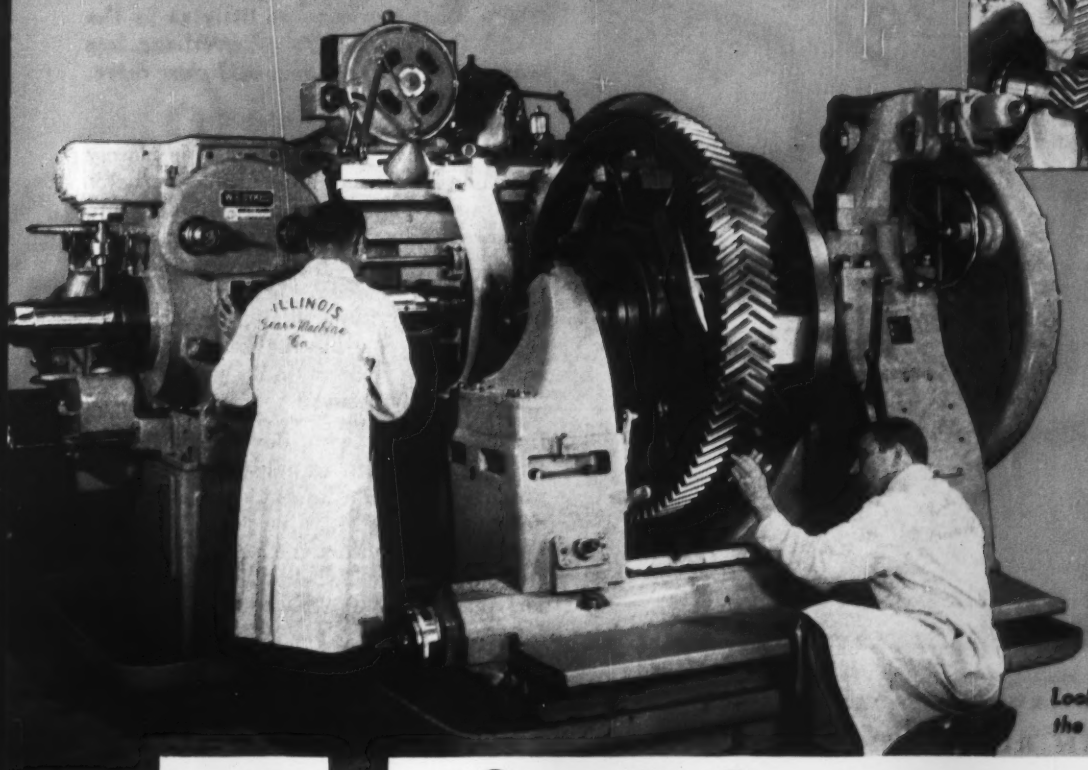
Here's how Illinois Gear makes sure of Quality in HERRINGBONE GEARS

If you could look down into the ILLINOIS GEAR plants you would see great batteries of the world's most modern gear producing equipment . . . manned by skilled craftsmen who *know* how to operate this equipment.

Typical of what you would see is the precision Herringbone Gear Generator and Testing Equipment, illustrated here. With unmatched facilities such as these ILLINOIS GEAR can produce one gear, ten thousand or more under the most exacting conditions of quality control . . . and meet delivery dates as promised.

If you are not now using ILLINOIS GEARS find out about the gears that can be made in any quantity with quality as the first consideration, as thousands of customers can testify.



Power testing Herringbone Gears under actual operating conditions.

The Herringbone Gear Generator has a 66" diameter and 18" face capacity. Other generators up to 134" diameter, 54" face capacity.

Look for this mark ILLG® *the symbol on finer gears*

ILLINOIS GEARS Reg. U.S. Pat. Off.

Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

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No Other Belt Drive Delivers as Much Power in as Little Space as R/M *Poly-V®* Drive!

Here's the answer to space saving design problems for heavy duty power driven machinery and equipment. Use of R/M's patented Poly-V Drive on this planetary miller almost doubled power capacity of the machine's drive . . . *without* increasing space requirements! Space saving advantages of this new concept in power transmission can improve drive design for a wide range of applications.

Single Unit Design

Poly-V Drive employs a single, endless parallel V-ribbed belt running on sheaves designed to mate precisely with the belt ribs. Single unit design gives Poly-V twice the tractive surface per inch of sheave width . . . to deliver up to 50% *more* power in the same space as a V-belt drive—*equal* power in as little as ⅔ the space! This means *less* shaft overhang, less bearing load . . . a compact, *lighter* drive.

Greater Drive Dependability

Poly-V's single unit design completely eliminates belt matching problems, helps maintain constant pitch diameter and speed ratios from *no* load to *full* load. You get longer drive life, greater drive dependability because drive performance is not limited to individual belt life or efficiency. And—just *two* cross sections of Poly-V Belt meet every heavy duty power transmission requirement!

R/M engineers who developed Poly-V Drive will be glad to assist you in determining the installation that will solve your design problems . . . give you "More Use per Dollar." Contact the R/M representative nearest you . . . or write for Poly-V* Drive Bulletin #6638.

**Poly-V is a registered Raybestos-Manhattan trademark*

RM738

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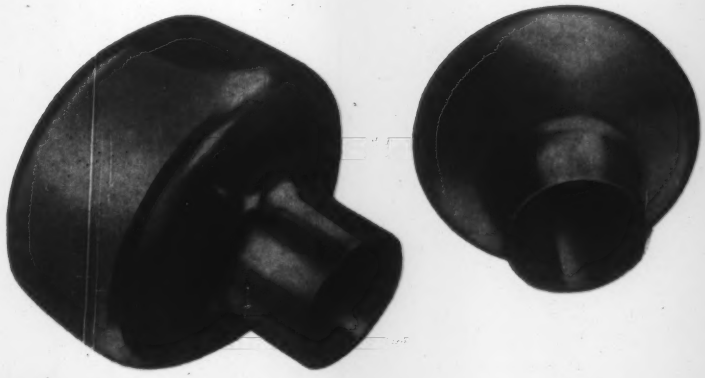
RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls



4 OF THE MANY STYLES OF THE ONE-PIECE SEAMLESS DOOR KNOBS FABRICATED FROM RUGGED REVERE BRASS STRIP.

REVERE BRASS STRIP Stands the Gaff!

The one-piece door knobs shown are drawn from a single blank of Revere Brass Strip, presenting an attractively smooth, unbroken surface without the need for seams or welds.

Because they are made by a unique procedure the manufacturer tells us that the brass must stand up under mighty rugged going, and that to produce the quality knobs they do, at an economical production level, the brass they use must have:

1. *Uniformity of gauge.*
2. *Absence of any sign of fracture or crimping when drawn.*
3. *Consistently correct grain structure to insure a smooth, flaw-free surface on the finished knobs.*

The manufacturer also tells us that Revere Brass Strip has been filling that bill, with utmost satisfaction, for some time.

Revere Brass Strip may be able to help *you* make a better product at less cost. You'll never know until you talk it over with one of our TA's (Technical Advisor). There's no obligation, of course. And such a discussion could save you a substantial sum of money. Such has been the case many, many times.

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REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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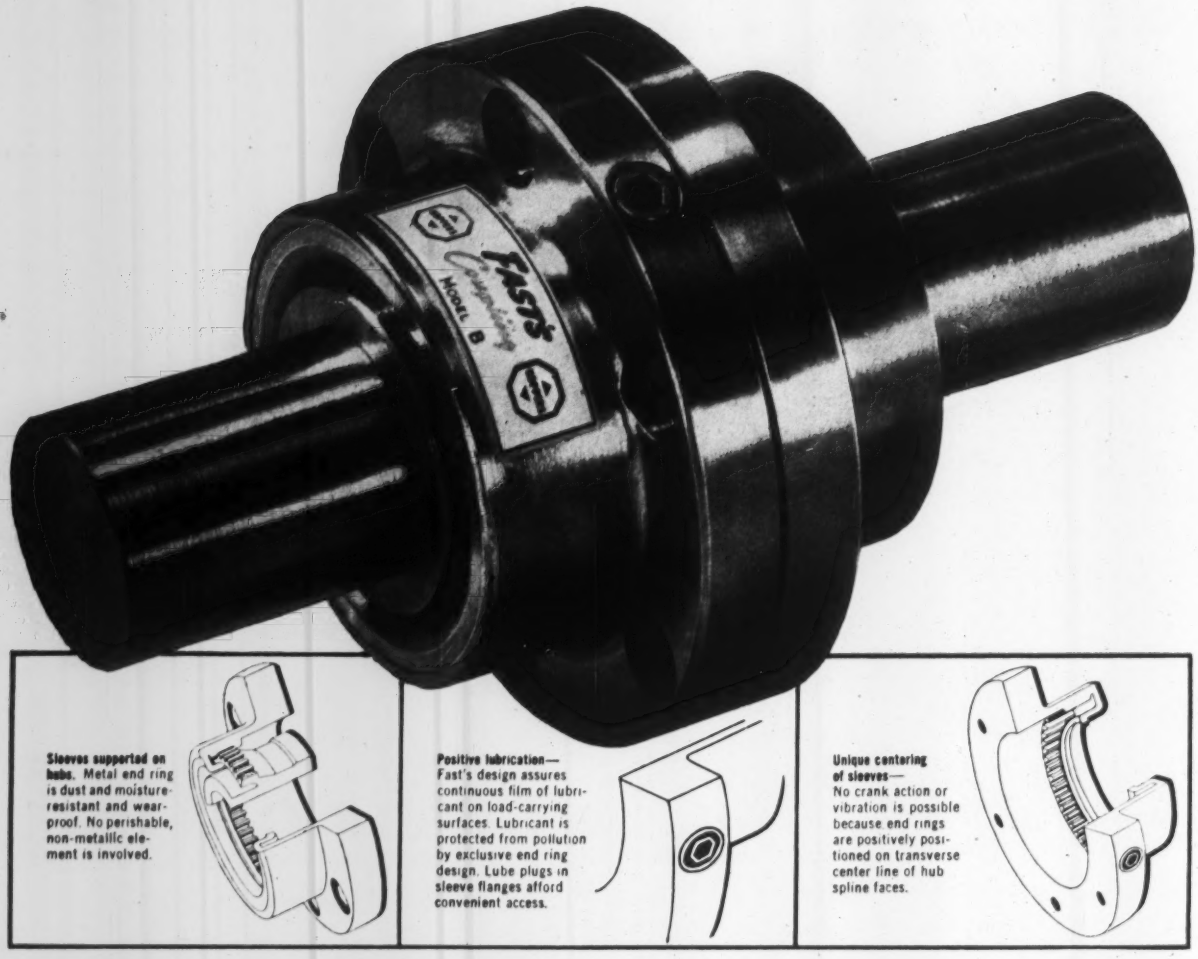
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Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.
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Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

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The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

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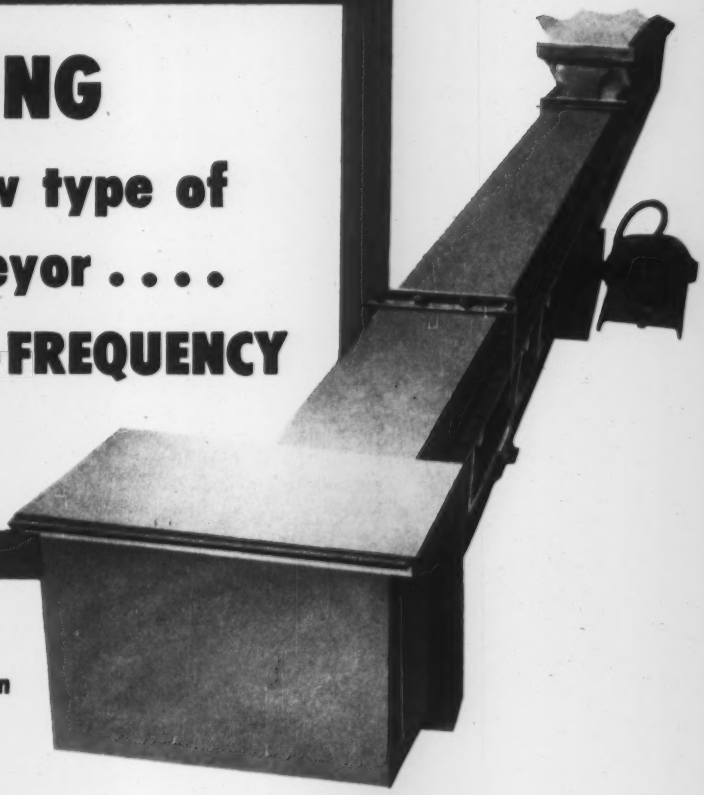
an entirely new type of vibrating conveyor . . . . THE NATURAL-FREQUENCY AIRSLIDE!



developed by
CARRIER Conveyor Corporation
and the **Fuller** Company

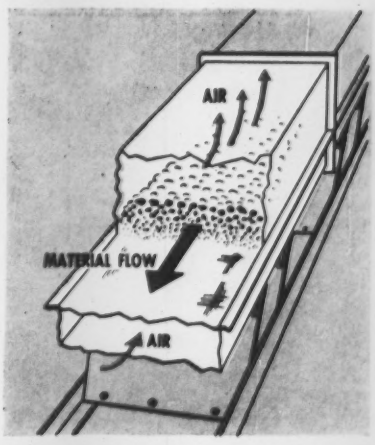
Conveys ultra-fine materials, plus lumps— upward as well as horizontally or downward!

Now, for the first time, processors of finely-divided materials can take full advantage of the vibrating conveyor. The new Natural-Frequency Airslide, developed jointly by Carrier and the Fuller Company, combines the operation of a vibrating conveyor with that of an Airslide. As a result, it will convey even the most finely-divided materials, by themselves or in combination with lumps—horizontally *or even upward!*

And look at these other important advantages: The Natural-Frequency Airslide is completely dust-proof because it's completely enclosed. There is no loss of headroom, because it isn't necessary to decline the conveyor. Large chunks — or dust — or both, can be handled efficiently, rapidly. Maintenance and down-time are appreciably less than for any other type conveyor.

Here's how it works: The rectangular trough of the vibrating conveyor is divided into two parts by a porous membrane. The upper portion of the trough is used to carry the material, while the lower part is used as an air chamber. In operation, a small, *non-critical* amount of air is pumped into the lower chamber and passed through the membrane beneath the material being conveyed. In this way, air which would normally be pulled down through the conveyed material, is balanced. This air balance, plus the Natural-Frequency vibrating action, conveys the finest materials at speeds and in mat depths which actually exceed those achieved for coarse products.

Get all the facts — now. Write today to Carrier Conveyor Corporation, 234-A North Jackson Street, Louisville, Kentucky.



CARRIER ~~NATURAL-FREQUENCY~~ CONVEYORS

MARSH PACKLESS RADIATOR VALVES

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GRADUATED

LOCK AND SHIELD

ANGLE PATTERN

GLOBE PATTERN

CORNER PATTERN (Sectional Below)

MARSH THERMOSTATIC RADIATOR TRAPS

ANGLE PATTERN

STRAIGHTWAY PATTERN

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F&T TRAPS

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No. 5 VENT, ONE OF MANY

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No. 500 INVERTED BUCKET TRAP

All the best of their kind!

You probably have made certain Marsh products your standbys without realizing there are a lot more of them just as superlative as the ones you like so well.

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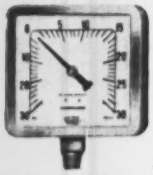

INTERNAL SYPHON (Square and Round)

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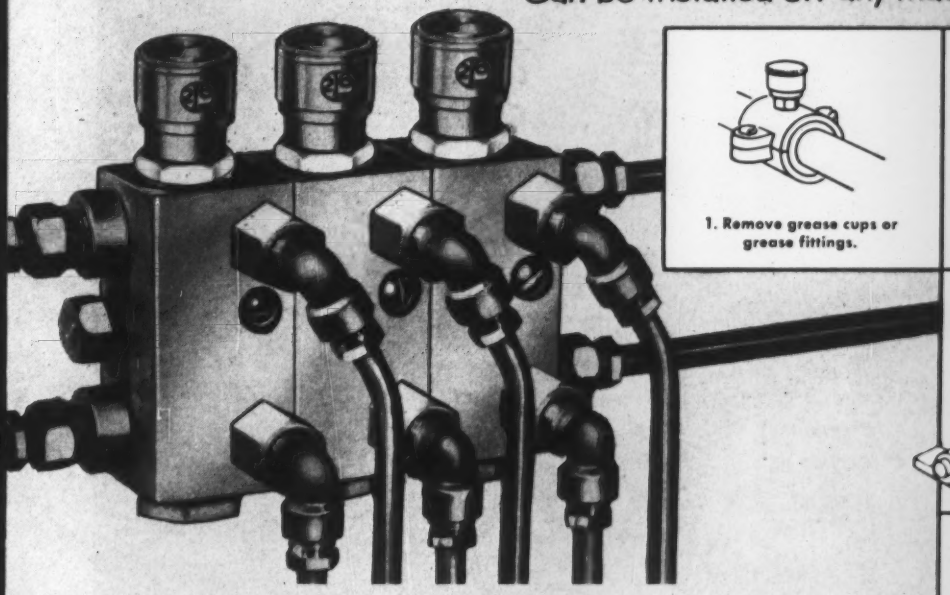
FASTER... FOOLPROOF... LESS COSTLY!

Meet toughest lubrication requirements

with this centralized

ALEMITE ACCUMATIC SYSTEM

Can be installed on any machine in 4 easy steps!



Type II Accumatic Valve

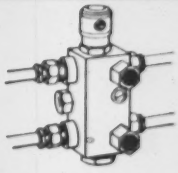
Handles difficult multiple-bearing lubrication under all conditions. Fully sealed for clean lubrication of power shovels, cement kilns, conveyors—any outdoor or indoor installation. Operates whether completely immersed in fluid . . . covered by dirt or grit . . . or protected by anti-corrosive paint. For fluid oil or light grease. Four sizes, delivering from .050 to .500 cu. in. of lubricant.

Fully hydraulic—no springs to adjust or replace.

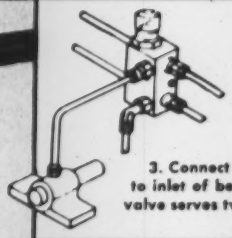
Now available with Lubrication Recording Cycle Counter—for a fully automatic record of bearing lubrication!

Tests show no appreciable variation in the amount of lubricant discharged after 73,312 cycles—equal to *122 years of twice-a-day service!*

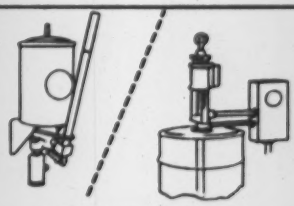
1. Remove grease cups or grease fittings.



2. Connect each valve in system to its two lubricant supply lines.



3. Connect valve outlets to inlet of bearings. (Each valve serves two bearings.)



4. Provide central pump for supplying lubricant to system.

ALEMITE ACCUMATIC ADVANTAGES!

- Prevents application of wrong lubricant.
- Seals completely against damaging dirt, grit and water.
- No parts are neglected—lubricates inaccessible and dangerous bearings at regular intervals.
- Eliminates product spoilage due to over-lubrication.
- Eliminates point-by-point lubrication methods—services all bearings in one operation.
- Delivers exact amount of lubricant to bearing.

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REG. U. S. PAT. OFF.
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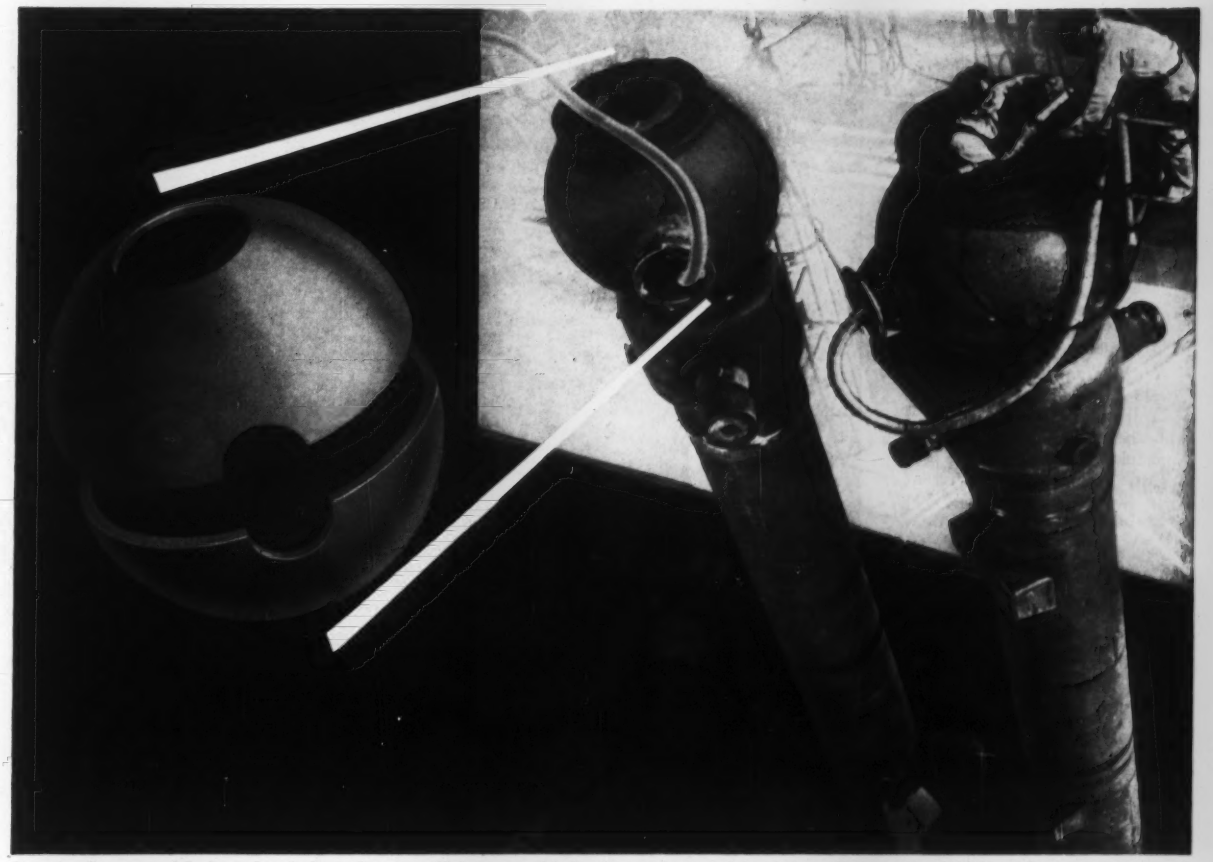


Imaginative use of Lukens heads brought new efficiency to fabrication and operation of these Braun spherical head feedwater heaters.*

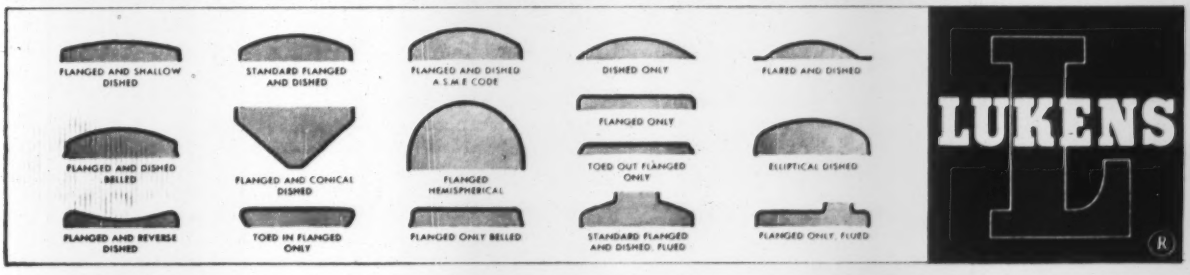
Now you can simplify . . . and save . . . designing with Lukens heads

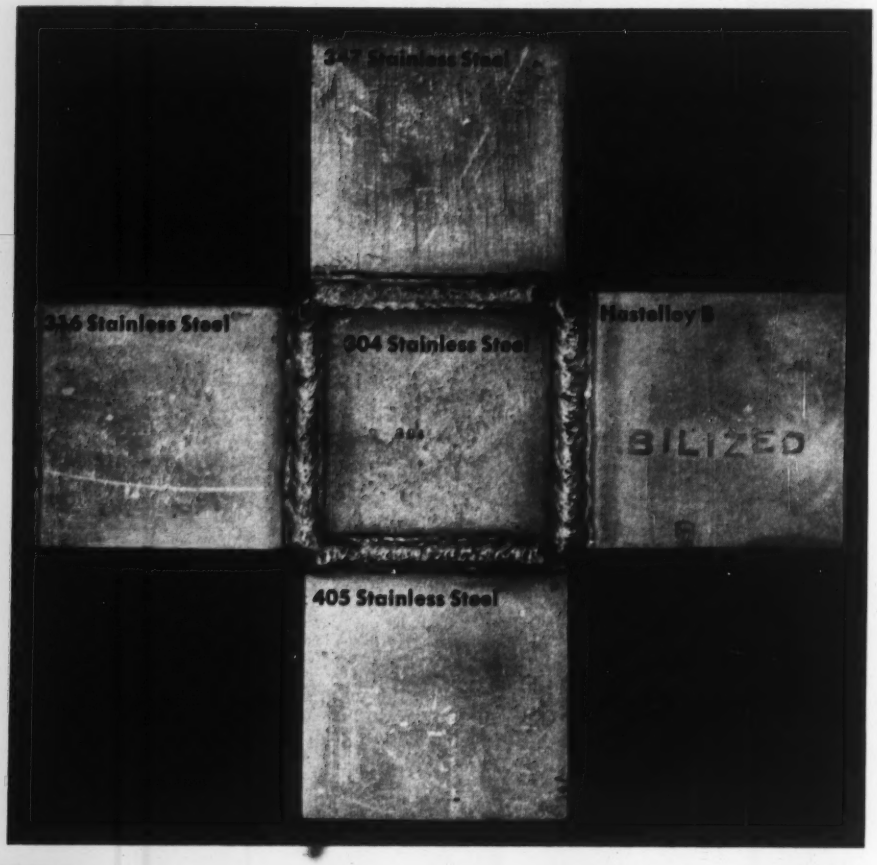
Here's practical imagination at work—C. F. Braun & Co.'s new spherical head feedwater heaters.* Each sphere is fabricated from two Lukens standard hemispherical steel heads. The benefits: High reliability . . . elimination of all flanges and bolted gasket joints . . . the ideal simple shape for economy of material and fabrication.

Fabricators of heavy and light machinery, valves, wheels, to name a few, have also benefited from imaginative use of Lukens heads. They've lowered costs, improved quality, streamlined fabricating methods. Lukens' fifty-five years as the leading producer of spun and pressed steel heads for many applications are at your service. Write for Catalog 931, "*Pricing and Engineering Data.*" Lukens Steel Company, Coatesville, Pennsylvania.

*Patents Pending

Lukens Offers the World's Broadest Line of Spun and Pressed Heads of Carbon, Alloy and Clad Steels





With versatile Inco-Rod "A" weldors produce strong, ductile joints in a wide variety of dissimilar alloys. In *this* test specimen sound welds were produced between four different alloys and the Type 304 Stainless Steel plate at center.

Versatility ...the big plus in Inco-Rod "A" that speeds production welding of dissimilar alloys

This 4-to-1 test specimen demonstrates some of the *varieties* of dissimilar alloys you can weld with Inco-Rod "A"* electrode.

In this specimen, Type 304 Stainless Steel is joined to Types 405, 316, and 347 . . . and to Hastelloy B. There's *proof* of versatility . . . the big plus that Inco-Rod "A" electrode alone can give you.

Industry is proving that Inco-Rod "A" electrode welds *most* dissimilar alloy combinations . . . ferritic and austenitic stainless steels, low alloy steels, mild steels, high nickel alloys, and other alloys.

Better than 90% of all such jobs in the average plant can be handled with this *one* electrode. No extra trips to the stock room!

No special training either. No special equipment. With Inco-Rod "A" electrode, weldors of ordinary experience produce strong, sound, ductile joints between dissimilar metals.

What's more, no preheat is needed for benefit of the Inco-Rod "A" weld metal. Of course, if preheat is normally required to protect either of the base metals to be welded, then it should be used. It won't harm the Inco-Rod "A" weld. Fortunately, many materials require only low (200-300° F.) preheats with conventional electrodes and the use of Inco-Rod "A" electrode may eliminate the need for this low preheat.

Do you need to join dissimilar metals?

Write for our new folder on Inco-Rod "A" electrode. It contains informative case histories . . . gives data resulting from test welds between *many* combinations of alloys. To get a copy only a postcard is needed.

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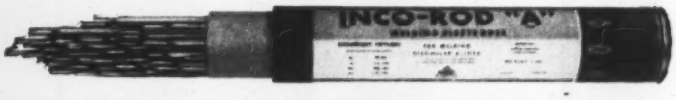
The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Welding Products**
electrodes, wires, fluxes



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OCTOBER 1957

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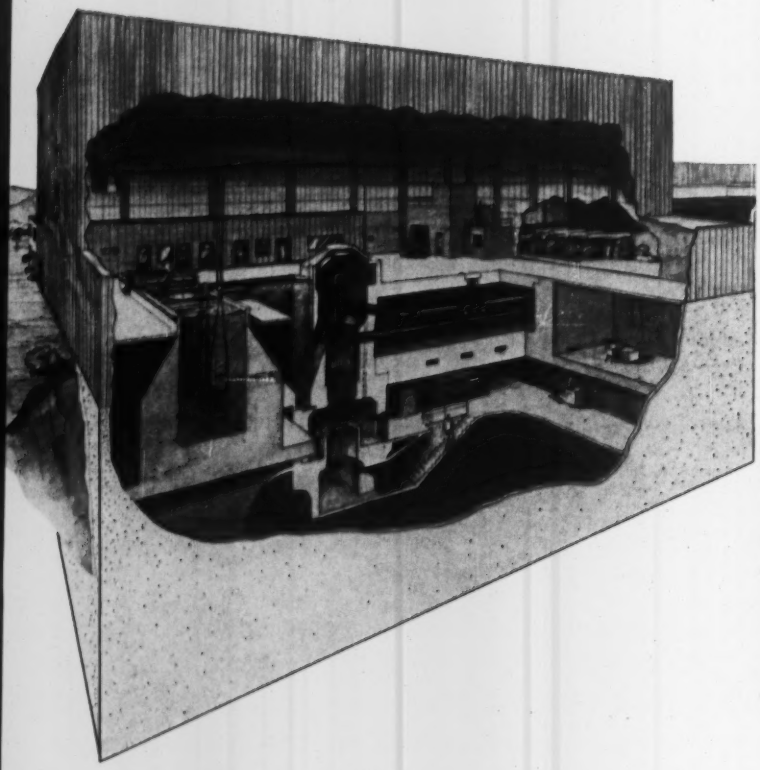
Engineering Test Reactor



The ETR will provide irradiation facilities urgently needed in the development of reactor components for military and civilian power reactors. The $14-million facility is the newest member of the family of reactors at the vast National Reactor Testing Station in Idaho. Two of the 3 floors of the reactor building are below ground. The reactor pressure vessel extends through all levels at the center of the building. The main floor is for servicing the reactor, such as installing uranium fuel. Below is the console floor, which contains experimenters' instrumentation and control equipment. On the basement floor is experimenters' radioactive equipment in shielded cubicles. At left is T-shaped water canal, which stores radioactive material removed from the reactor vessel. Pipes to right of vessel carry the water coolant to and from the heat exchangers in the wing at far right. The ETR will be used principally to determine the effects of intense neutron and gamma ray bombardment or "radiation damage" on engineered components and materials. For further details and photos see page 944 in this issue.

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OCTOBER 1957

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Editor*

MECHANICAL ENGINEERING

Dr. Irving Langmuir

THE recent death of Dr. Irving Langmuir, 1934 ASME Holley Medalist, brings to a close the career of one of the great scientific geniuses of modern times. His death also gives rise to thoughts of his many accomplishments during his long career on the staff of the General Electric Research Laboratory from 1909 to 1950.

For example, Dr. Langmuir developed the gas-filled incandescent lamp, the high-vacuum power tube, atomic hydrogen welding, a highly efficient screening-smoke generator for the military, and methods for artificial production of snow and rain from the clouds.

The gas-filled lamp, which after its original development was further improved by Dr. Langmuir and others, increased many times the efficiency of electric lamps. In terms of modern illumination levels, development of the gas-filled lamp and its subsequent improvements save the American people almost one billion dollars per year in electric light bills.

The high-vacuum power tube, which permitted use of high voltage in radio sending and receiving for the first time, gave modern broadcasting its "heart" and is regarded as probably the greatest single development in that field.

Atomic hydrogen welding made possible for the first time the easy welding of aluminum and chromium and other hitherto unweldable metals and permitted the joining of extremely thin sheets of metal, which would be burned by other processes.

With Dr. Vincent J. Schaefer, Dr. Langmuir developed a new technique for producing huge quantities of extremely dense screening smoke which proved highly effective in concealing tactical movements of troops and supplies in combat in World War II.

More recently, Dr. Langmuir's work—conducted with Dr. Schaefer and Dr. Bernard Vonnegut while the Research Laboratory had a joint program of weather research with the Army Signal Corps and the Office of Naval Research—resulted in the discovery of methods by which precipitation may be induced from certain types of clouds.

The three scientists developed methods of producing snow and rain from supercooled or below-freezing liquid clouds by seeding them either with dry ice or with the compound silver iodide.

Dr. Langmuir received the world's top ranking scientific awards for these and other accomplishments, including the Nobel Prize in chemistry granted to him in 1932.

In 1934, the ASME awarded the Holley Medal to Dr. Langmuir. This medal was instituted and endowed in 1924 by George I. Rockwood, an Honorary Member and past vice-president of ASME, to be bestowed for some great and unique act of genius of engineering nature that has accomplished a great and timely public benefit. Certainly, no better selection could have been made, for Dr. Langmuir's scientific discoveries were acts of genius and were of great benefit to the public. The Holley Medal was presented to Dr. Langmuir for "contributions to science and engineering, especially in the development of the gas-filled incandescent lamp, of the thoriated filament for thermionic emission, of atomic-hydrogen welding, of phase-control operation of the thyratron tube, and in fundamental research in oil films."

Thus, with the passing of Dr. Irving Langmuir, the world loses a great scientific genius, but it is sustained by the vast amount of knowledge and inspiration that he has left.

Engineering Approach to RADIOLOGICAL CONTAMINATION

THE nuclear detonation of March 1, 1954, at the Eniwetok Proving Grounds covered about 7000 sq miles of the earth's surface with significant amounts of radioactive fallout, most of this area being otherwise undamaged by the detonation.[1]

The removal of the fallout consisting of fission products as well as thousands of tons of solid materials dug from a crater by the detonation presents a major problem for which economical solutions have been sought by the Naval Radiological Defense Laboratory.

On the average, about $^1/_{20}$ lb of material would have to be removed from each square foot of property, transported to a noncritical location and disposed of, before the site was reoccupied.

One obvious method of removal for all but earth surfaces is the use of a water stream to not only dislodge the material but to carry it away. If the contaminant is held tenaciously to the surface, detergents and scrub brushes can be used to help loosen the material. Other techniques could include steam cleaning, vacuum cleaning, and air-jet cleaning. If the material were attached very tenaciously, surface-removal techniques such as paint removal, sand blasting, or the removal of a layer of earth by heavy equipment would be necessary. Unflushed material would have to be collected and transported in bulk to a disposal area.

Applied shielding primarily involves earth-moving techniques—covering the contaminant with a layer of clean earth, or burying it by plowing or disking it under the surface.

The engineering problem of decontamination involves putting these techniques into efficient and effective practice on a large scale.

Studies have indicated that such reclamation operations are feasible. For instance, about one half the area of San Francisco could be decontaminated in about 30 days by 11,000 men using only locally available fire hoses and earth-moving equipment. This assumes that the fallout would be of a type that is relatively easy to remove.

Mechanization can greatly facilitate decontamination. Street flushers, for instance, as compared to fire hoses require only about one twentieth of the man-hours per unit area. However, the supply of street flushers is far more limited.

Use of Available Equipment

One phase of the laboratory's work is developing efficient use of available equipment that is used daily by municipalities, contractors, and the Armed Forces; for example, street flushers. Flusher operations can be facilitated by using relatively ineffective mechanical street sweepers to pick up the bulk of the material. An over-all increase in rate, and a decrease in equipment and water requirements for flushing can thereby be achieved.

Some existing equipment could be modified to improve its performance. Earth scrapers would remove only half the tonnage if they could be modified to remove a 2-in. layer instead of the customary 4-in. cut, since the contamination is generally only 0.006 in. deep.

The assembly of available components into improvised units is another approach. Fig. 1 shows a street flusher built on a flatbed semitrailer with three 1000-gal standard Navy pontoons used to store the water. A 500-gpm fire-fighting pump provides power, and a simple manifold is used to distribute the water. One of these units has been successfully tested in the field.

Fig. 2 shows the layout of a street vacuum cleaner that might be improvised from a commercial furnace cleaner. A number of individual hand-held outlets could be used in small areas around buildings and other obstructions. This unit might serve where freezing conditions exist or water is limited.

There is a definite need for new equipment. Many cleaning principles used on a small scale have never been developed for large-scale operations. High-speed vacuum cleaners are currently being used to remove from runways the small rocks, bolts, and other debris to which the intakes of jet aircraft are vulnerable. Units like the one shown in Fig. 3 may be adaptable to the problem of decontamination.

[1] "Civil Defense for National Survival," 24th Intermediate Report of the Committee on Government Operations; Union Calendar no. 1203, House Report no. 2946, U. S. Government Printing Office, Washington, D. C., 1956, p. 21.

Contributed by the Nuclear Engineering Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Based on ASME Paper No. 57—SA-52.

Fig. 1 Street flusher built on a flatbed semitrailer

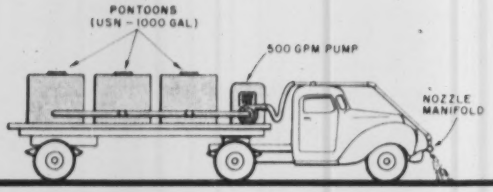
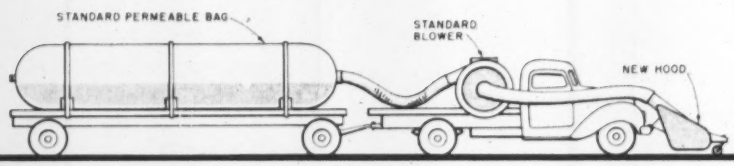


Fig. 2 Layout of a street vacuum cleaner that might be improvised from a commercial furnace cleaner



Many other cleaning operations such as sandblasting, power scrubbing, and steam cleaning are effective but relatively slow. The same is true of chemical-paint stripping, hot-liquid jet washing, and flame cleaning. It may be worth while to develop these techniques into high-rate methods, particularly if the tenacious wet fallout from a surface-water detonation is expected.

Other principles deserve evaluation. Air jets of high velocity, perhaps in the sonic range, very high-pressure water jets, ultrasonics, and static electricity have potential value.

Automatic decontamination also merits consideration. The Navy is presently adopting a washdown system for its ships which provides effective decontamination. NRDL is exploring the feasibility of similar systems for certain types of buildings. Fig. 4 shows a concept of roof washdown on an industrial-type building. For economic reasons, such systems probably would be used only on critical installations. However, other systems are possible—remote-controlled street flushers, or those guided by electromagnetic field from buried cables laid in a predetermined pattern are not completely impractical.

Protective construction is one of the most fruitful areas of development. Modifications can be made to existing buildings, streets, paved areas, or land areas to facilitate decontamination by reducing entrapment and/or absorption of the contaminant, and improving its transportation by gravitational forces.

In practice, protective construction for reducing the tenacity of radiological contamination involves the use of smoother, nonporous surfaces, increased slopes, and more ideally spaced drains. More than twice as much water is needed to decontaminate rough roof surfaces as smooth ones. Substituting paved areas for landscaped ones, less terracing, and simplified landscaping also facilitate decontamination.

NRDL is responsible for developing information pertinent to this problem. Much assistance is needed in the application and implementation of these techniques. To provide a link with the potential user, a revisable loose-leaf reclamation-protection engineering handbook is being prepared, which will summarize what little is known. Methods for preattack protection construction and reclamation procedures will be suggested and their effectiveness and cost indicated for a wide variety of attack conditions, operational requirements, geographical environments, and types of target.

Summary and Conclusions

The contamination of our environment by radioactive materials is a problem resulting from nuclear developments. While only fallout resulting from weapon detonations has been discussed, similar situations can result from laboratory spills, reactor accidents, and routine operations without adequate safety controls. The areas affected will be smaller, but the reclamation or decontamination problem would be the same.

Present and past research and development have provided a basis for establishing procedures for reclaiming large areas. Continued development is required to establish more efficient, more effective, and more practical decontamination operations. In order that this development be accomplished within a reasonable time, many more people must be aware of the problem and alert for ideas, techniques, and improvements that will contribute to adequate solutions. Only by the application of the skills, ingenuity, organizational ability, and imagination of personnel in such fields as equipment design, plant maintenance, building design, utilities, and fire protection will the nation be able to cope adequately with radiological contamination.

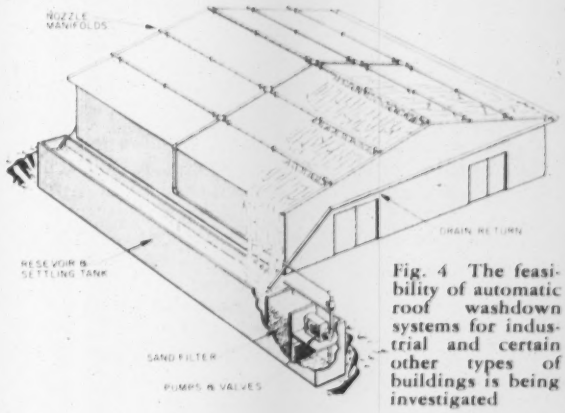


Fig. 4 The feasibility of automatic roof washdown systems for industrial and certain other types of buildings is being investigated

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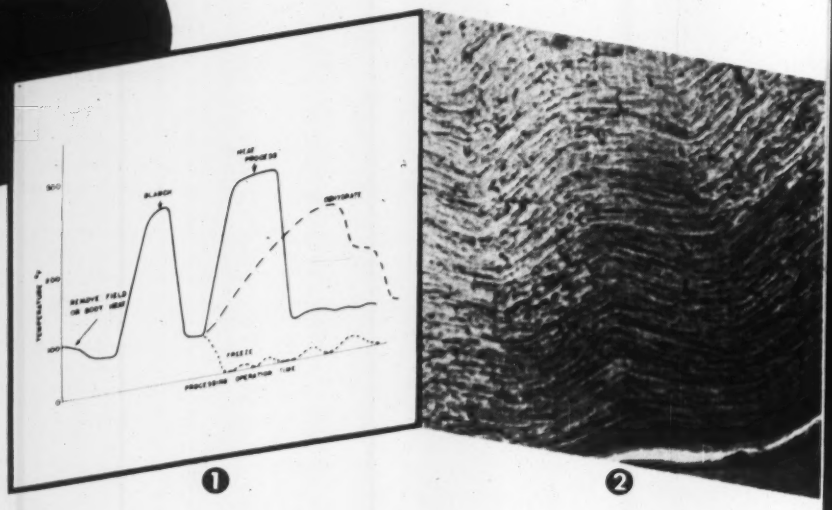
Thousands of square miles will be contaminated by radioactive fallout of immediate hazard to personnel. The occupancy of contaminated areas after detonation will require that they be decontaminated and reclaimed.

Fig. 3 Experimental airfield vacuum cleaners may be adaptable for decontamination purposes

HEAT TRANSFER in the Food Industry

From the viewpoint of the engineer, food preservation presents a new complex of heat-transfer problems[1]



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Heating and cooling cycles (Fig. 1) applied to an ideal commodity, illustrate the commercial processing of food. The term "blanch" describes preliminary heat-treatment used on many foodstuffs (often to fix color, loosen skins, change texture) before the product goes into its sealed container. The major heat-treatment—and the major

Heat Processing of Foods[2]

Most of the efforts spent in processing food are for one or another kind of preservation. Preservation in this case means literally the preservation of quality at point of harvest, slaughter, or manufacture in an effort to prevent the regressive ravages of time, temperature, microbiological and chemical changes on the so-called quality attributes of food which we the users detect in eating, and metabolizing the resulting product.

In fresh handling of such commodities as peaches, broccoli, fresh meat, and many others, one of the first heat-transfer operations is to remove field heat from vegetables or body heat from animals. This operation while physically simple involves irregular geometries, differences in physical characteristics among tissues found in a given specimen, and differences in the rate of reaction of both chemical and microbiological systems of the budget.

Preparation Techniques

In most food-processing operations, however, the harvesting operation is followed by a series of preparation techniques which usually involve removing inedible portions of the product in preparing for further processing of those portions which are most desirable. Animals are usually slaughtered, bled, eviscerated, skinned, cooled, and further prepared by cutting out into wholesale or retail cuts. Vegetables and fruits are generally peeled, pitted, sliced, diced, etc., in preparation for further processing. During or following this period of separation many commodities are subjected to a brief heat-treatment for a variety of purposes. This heat-treatment (blanch or scald, as it is often called) is used to fix color, to loosen skins, to change the texture of the product, to kill some of the microorganisms, to gelatinize starch, and for a variety of other purposes.

For canning, the temperature is raised up to perhaps 250 F after the product has been placed in a hermetically sealed container. This temperature is usually held for a length of time thought to be sufficient to kill virtually all of the spoilage and toxin-forming organisms which otherwise might survive to the detriment of the consumer. Freezing, on the other hand, goes in the opposite direction where the same chemical or microbiological processes are brought virtually to a halt by lowering the temperature sufficiently to impede their progress.

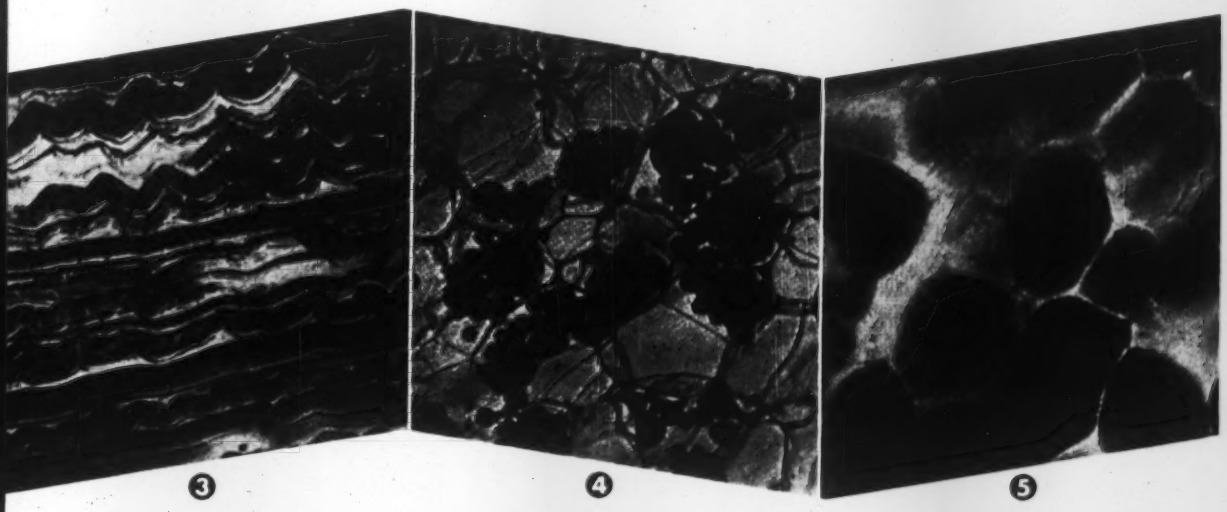
In general, some idea of the changes in temperature during the life of a food product may be gained from Fig. 1. After harvest, field heat is removed and the temperature is maintained as low as possible in practice while the commodity is transported to the processing area. At this point a blanch may be applied which probably reaches temperatures in the neighborhood of 200 to 220 F. This is followed by rapid cooling and the preparation period already outlined. In the event that the commodity is to be canned, the container is placed in a retort and raised to temperatures between 200 and 300 F and then cooled as rapidly as possible, after which the containers are cased and held at temperatures approximately ambient for the location in question.

For dehydrated material the temperature is raised to a

[1] Condensed from two papers contributed by the Heat Transfer Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of The American Society of Mechanical Engineers.

[2] Condensed from "Heat Transfer in the Food Industry," by R. G. Tischer, Director, Food Laboratories, Quartermaster Food and Container Institute, Chicago Ill., and H. Hurwicz, Assoc. Mem. ASME, Sr. Scientist, Avco Manufacturing Corporation, Lawrence, Mass. ASME Paper No. 57—SA-65.

heat-transfer problem—occurs after the food is in its container. In heat-treated canned meat, variations in meat structure, as well as variations in heat resistance of meat in different directions, affect calculations. In a fowl section (Fig. 2) taken 30 min after killing, note prominent longitudinal striae, slight waviness, poorly differentiated fibers. In a roaster aged three hours (Fig. 3), rhythmic waves of passive contraction can be seen (pictures magnified 100 times). Intact starch grains in cells of fresh potato (Fig. 4), and gelatinization of starch in steamed potato (Fig. 5), show the heterogeneity encountered in these biological systems.



considerable degree during the drying cycle, after which the product is stored again under conditions similar to those used for canned products.

For frozen commodities, temperatures are lowered as rapidly as possible and maintained at a low level.

Changes in Food Products

It is important at this point to pause to consider what it is in a food product which is altered through the influence of temperature and time and treatment. Important members of this list would surely be flavor, odor, texture, consistency, nutritive quality, volume, weight, and toughness. These are worth mentioning at this point because every effort put into the improvement of food processes centers around the resulting level of these component attributes. No amount of information, no matter how precise, concerning food products is of any ultimate interest from the point of view of product quality unless it affects one or more of these attributes.

Nutritional losses result from almost every process applied to food. There is hardly an important case where nutritive value is markedly increased by the processing technique employed. The result of this is the employment of fortifying procedures for such items as bread, milk, and other beverages.

Processing Problems

In considering the solution of these problems three factors are of outstanding importance. These are: penetration, diffusion, and heat transfer. In the canning process the food product is usually packaged in one or another size of cylindrical container, while in the freezing process the geometry usually resembles a slab. The cylindrical container, after sealing, is subjected to an atmosphere of steam or other means of heating in which the processing takes place. A considerable amount of work has been done in attempting to discover as much as possible about the penetration of heat into a canned commodity.

The persistent heterogeneity of all biological material is well known to cause endless difficulties in the fine mathematical treatment of biological systems. Fig. 2 shows clearly the influence of striation of muscle on the anisotropy of this type of product. This anisotropy applies not only to heat transfer but also to chemical changes and microbiological changes. The structure of muscle is such that it conducts impulses, fluids, and gases in one direction much more readily than in another. It is well known, for instance, that diffusion through the sheath of muscle cells is much slower than it is through the length of the muscle.

Changes of the type shown in Fig. 3 are another mark of heterogeneity in biological systems. In this case, the change of potato cells from the uncooked to the gelatinized state indicates the marked difference in the structure of these cells after the application of heat.

These changes and many more like them are bound to have a marked influence on the passage of heat, the occurrence of diffusion, and the character and extent of chemical changes in both vegetable and animal tissue.

Improving Heat-Treatment Processes

We need to know considerably more than we do about the loss of volatile flavor components in all processes involving heat. An example of this would be canning of meat. In this process desirable flavors are lost and undesirable ones are formed during the heat process. Whether it is possible by some other heat-treatment to minimize the loss of flavor and maximize the loss of off-flavors is not yet known. Treatment of meat by ionizing radiation may be used to sterilize the meat and

in many cases produces a highly acceptable meat product. There are undoubtedly many other treatments which could be used to avoid difficulties encountered in high-temperature treatment of meat.

If engineers are willing to face the endless complexity of biological systems, it seems certain that the reward of work in this direction will be far-reaching improvement over the present methods of food processing.

Heat Transfer in Canning[3]

In the study of all food-preservation processes, two objectives are always to be attained:

1 A palatable product acceptable to the consumer.
2 A product which will not endanger the health or life of the consumer.

The second objective is fairly easily achieved, usually at the expense of the first.

Foodstuffs are processed in a variety of containers of different geometries. Each geometry calls for a solution of a boundary-value problem involving, e.g., heat-conduction differential equation. The initial and boundary conditions being of different nature, these problems alone call for a good heat-transfer man and mathematician to determine the temperature-time-space relationship in the container and thus predict the temperature distribution from the theory. The solution of such problems would be of extreme value to the food field. Here the effect of heat-transfer coefficients at the container boundary may be quite important.

There are very scant data on specific heat, thermal conductivity, and diffusivity of foodstuffs, and there is urgent need for such determinations.

The determination of the best steam-bath time-temperature relation, or the use of dry versus wet heat, or preheating of the material before enclosing in the container offer some examples of problems one may encounter.

The design of a processing container to obtain best heat-transfer conditions may be given as another example of present needs.

In the past decade a new approach to the problem of determination of an adequate process has been developed by Stumbo, Hicks, and Gillespy. The methods based on the new concepts involve a change in emphasis from the center location in the can to the whole can volume as a criterion of the adequacy of a process. To apply the newer concepts to the actual heat-processing of various commodities it is necessary to have detailed data on temperature distributions within cans packed with these commodities, and to derive the sterilizing-value distributions from the temperature distributions.

Empirical Study

The objective of the present work was to determine empirically the functional relationships existing among temperature, time, and space during processing of beef at high retort temperatures.

(The authors present an equation expressing the theoretical can temperature at a location, in terms of the retort temperature, the initial temperature, and the cooling-bath temperature, and certain constants and coefficients which are described and tabulated.)

Without going into details of the experiment, the results of this phase of the investigation may be summarized as follows:

An investigation of time, temperature, and space relationship during canning of beef extended to high retort temperatures (up to 315 F) was made. Thermal histories were obtained for 25 locations in 300 × 308 cans packed with round of beef. The functional relationships were determined by regression methods for the heating and cooling phases of processing with the exception of first 10 min of the cooling ("intermediate" cooling). Physical properties of beef not available in the literature have been ascertained.

In addition to the establishment of empirical relationships by means of the determination of correction factors for the theroetical relationship for the whole space of the can (not only the geometrical center) for both heating and cooling phases, a method has been devised to obtain empirical constants for the cooling phase from experimental data gathered during heating.

Residual Effects

The lag in cooling observed immediately after the end of the heating phase has been long recognized in the studies of heat penetration into cylindrical containers undergoing a thermal process. Most research workers investigated the center of the can, and several attempts were made to find a mathematical formula expressing the time-temperature relationship in the early stages of cooling. The formulas derived assumed this relationship to be (in terms of degrees above the cooling-water temperature) a monotonic-nonincreasing function from the beginning of cooling, or time when cooling water was started and steam cut off. This assumption might have been justified for all practical purposes for low-temperature, long-time heating processes; however, it has been observed that, for relatively short processes and especially for high temperatures, this assumption is not justified by the experimental facts.

The data collected during the present experiments furnish the basis for determining effective retort holding times. This method may result in shorter but safe processing times, and may increase the palatability of canned beef and other products.

On the basis of the experimental results the following conclusions are drawn:

Neither the theoretical solution of the heat-conduction equation nor a monotonic function approximates the experimental results for the intermediate cooling phase.

The residual heating at the beginning of the cooling phase increases the effective processing time. This increase is most pronounced for short-time, high-temperature processes. The contribution of residual heating to the sterilizing effect displays the same trend and possibly reaches maximum at 297 F retort temperature.

Acknowledgment

This paper reviews research work undertaken at Iowa State College, Ames, Iowa, in co-operation with the Quartermaster Food and Container Institute for the Armed Forces. The sets of round cuts of beef were supplied by Armour & Company, Chicago, Ill.

[3] Condensed from "Heat Transfer Work in Food Processing Field," by H. Hurwicz and R. G. Tischer (see footnote No. 2). ASME Paper No. 57—SA-18

The Hot Airplane

Airframes for supersonic flight demand a new spectrum of engineering materials to withstand high-temperature operation

By H. B. Sipple[1] and G. G. Wald[2]

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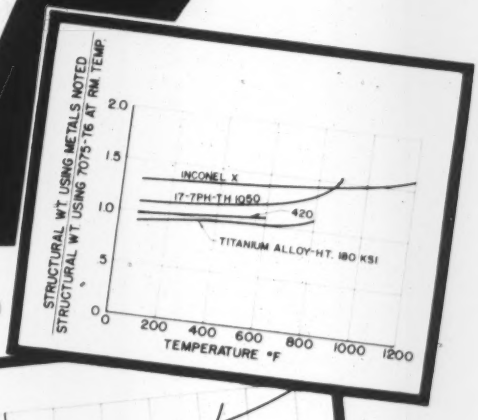
AIRPLANES for supersonic flight at high Mach numbers require heat-enduring materials for airframes and equipment. Such materials are now the limiting design factor. Present aerodynamic and power-plant technology can carry us far beyond the heat limits of our airframe metals. Studies of temperature ranges at high speeds indicate there will be no critical temperature problems in the design of transports; but temperatures ranging from a few hundred degrees to approximately 1200 F must be considered in the design of fighter and bomber types.

For the future, there will be heat-resistant materials expected to result from various long-range development programs undertaken both by government and industry. Meanwhile, the Lockheed Aircraft Corporation is carrying on a continuous study of available materials and the modifications of those materials which can be produced with relatively little development. The high-temperature capabilities and limitations of the existing materials are being established, and the specific design criteria developed.

In conventional aircraft, today, structures near engines and afterburners, and equipment and lines operated and fed by the engine exhaust are exposed to high temperatures. Therefore materials are readily available for this job. These include stainless steels, commercially pure titanium, Inconel, and so on. The basic problem arises from the fact that present aircraft are constructed primarily of aluminum with the use of steel for heat resistance in localized areas, whereas the high-performance supersonic aircraft, because of aerodynamic heating, will be fabricated from titanium alloys and steel or other heat-resisting materials, and aluminum will be used in the local areas where temperature will permit. Thus the materials that were formerly the exception now become the rule.

Obviously, the structure will be heavier. Fig. 1



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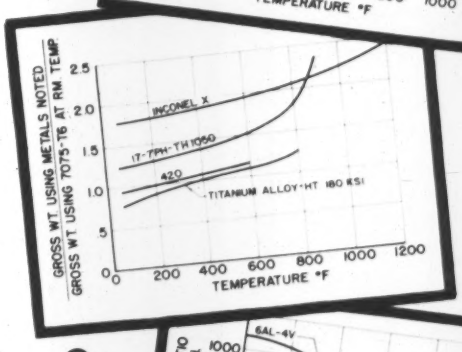

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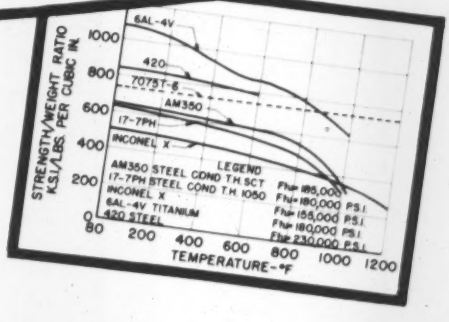

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[1] Group Engineer, Materials and Processes.

[2] Research Specialist.

Contributed by the Aviation Division and presented at the ASME Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—SA-72.

Fig. 1 This is how airplane structure grows heavier when designed for increasingly high operating temperatures. Heat-resistant materials are compared with aluminum alloy at room temperature. Curve for titanium is based on estimated properties of heat-treatable titanium alloys proposed by the Department of Defense.

Fig. 2 As structural weight increases, power, fuel load, and over-all size go up, since the plane must accomplish the same mission as before. Here is gross weight plotted against the increasing temperatures. For a fighter plane, each added pound of structural weight ultimately results in an increase of 10 to 15 lb of gross weight.

Fig. 3 The tensile strength/weight ratio of sheet materials versus temperature. Curves for bar material show a similar decline, as do the curves for compression yield strength and for modulus of elasticity. A broken line has been drawn across the chart to represent the strength/weight ratio of aluminum alloy at room temperature.

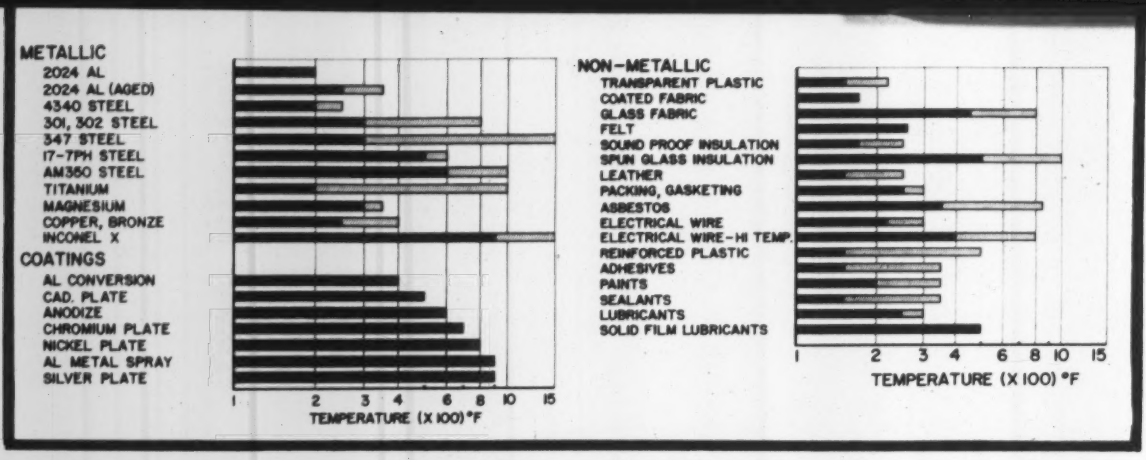


Fig. 4 These charts show the general temperature limitations of common aircraft materials including many of the nonmetallic items. They indicate the temperature at which an appreciable drop-off occurs and the temperature above which the material is considered unusable for design purposes.

illustrates the increase in structural weight at elevated temperature. Notice that to do the same job at high temperature that aluminum has done at room temperature, a penalty in structural weight on the order of 25 per cent can be expected on airframes designed for exposure to the relatively low temperature of 600 F, assuming use of the materials which are currently available. Experimental high-strength materials such as 420 and some of the heat-treatable titanium alloys, show possible promise of equaling the performance of aluminum, provided other properties will permit exploitation of their higher strengths.

Weight and Growth Factor

Of what significance is this weight penalty? Normally it might be expected that an increase in structural weight would reduce the pay load or decrease the rate of climb, reduce the range, or perhaps increase the runway requirements; but in practice, this is not usually true. Airplanes are designed to accomplish a specific mission or objective. The use of low-strength material adds to the structural weight which requires an increase in the gross weight to satisfy the original performance requirements. Unfortunately, the increase is far out of proportion to the increase in structural weight. This is because the addition of weight to the structure requires addition of more power to carry the additional weight which, in turn, requires more fuel. These additions in turn require added structure. This cycle continues in converging geometric progression, and when the design is finally established, each pound of weight added to the structure has caused the gross weight of the airplane to increase by 10 to 15 lb in the case of a typical fighter, depending on the performance requirements.

Fig. 2 illustrates the effect of increased structural weight on airplane gross weight for the heavier materials at elevated temperature compared to aluminum alloys at room temperature. Assuming the use of currently available high-temperature materials, an airplane suitable for 600-F operation can be expected to weigh one and one-half times as much as its present counterpart in aluminum alloy. Again, a comparable hot airplane constructed from promising high-strength experimental titanium or heat-resistant steel alloys would be competitive in gross weight with current aluminum airplanes.

Research and Development

The foregoing figures clearly show the tremendous advantage to be gained by use of the titanium alloy and heat-resistant steel sheet and bar products heat-treated in the ultra-high-strength range. The experimental nature of these materials must be kept in mind, and a concerted effort must be made to bring these materials to production status. The sheet-rolling program sponsored by the Department of Defense to provide heat-treatable titanium alloys in the desired strength range is a commendable step in this direction. This program is also illustrative of the tremendous effort which is required to bring about such developments. We believe that the martensitic hardening steels, such as the 400 series, represent another major field of necessary investigation which has been relatively untouched.

Although the properties of nickel-base alloys are not attractive in the lower temperature ranges, these materials will be essential in the higher temperature ranges, and research and development of these materials should be encouraged to produce higher strengths at temperature. Significant improvements undoubtedly are possible in these alloys in the intermediate temperature range; i.e., under 1200 F by variation in mill-processing and heat-treating practices. These investigations should be undertaken immediately.

However, before these new materials can be used on production aircraft, their producibility, structural reliability, uniformity, design properties, fabrication characteristics, and processing limitations must be established.

Adequate resistance to crack propagation is one of many properties these new high-strength materials must possess. The fatigue-strength to tensile-strength ratio of these high-strength materials should be comparable to the materials now in use. Creep strength is also a factor which bears much further investigation to establish criteria needed for sound design at elevated temperatures. It is a phenomenon which may become the most critical element in selecting materials for long-time exposure to stress at elevated temperatures. Corrosion and high-temperature oxidation are also obstacles to be overcome. Stress-corrosion cracking or embrittlement on aging or strain aging must be avoided in these materials.

Fabrication and Processing

The job does not end with development of materials which satisfy the foregoingr equirements. Remember, these materials must be made into parts and assemblies, and we expect that the shift to the high-strength heat-

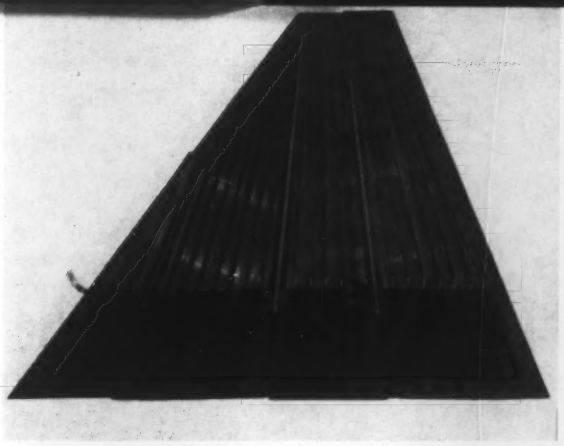


Fig. 5 Integrally stiffened extruded outer wing for the Lockheed Constellation. Also extruded are wing spar caps, longerons, and floor beams.

resistant materials will cause difficult problems for both the producer and the fabricator. The aircraft industry up to this time has operated an aluminum shop. The hot airplane will require completely new manufacturing methods.

New high-speed forming techniques such as explosive forming show promise of producing required shapes in these high-strength metals which cannot be produced by other known means. These techniques must be fully explored and developed.

Studies comparing the machinability of the high-strength, heat-resisting steel, and titanium products show that the hardened materials must be machined at a much slower rate than is possible with the present nonferrous materials. These studies also indicate the need for more heavy-duty machines with higher horsepower and more rigid construction capable of operating at higher loads.

It may be necessary to expand the machine-tool requirements in our industry by as much as four to ten times to accommodate the production of heat-resistant airframes, at the rate of production for current airplanes. This points out the necessity for improvement in machining characteristics of materials and the vigorous exploration of new techniques for metal removal, including chemical and electrochemical processes. The introduction of steel and titanium products which are suitable for welding undoubtedly will result in greater interest in the use of welded structures as a means of minimizing the weight of joints. It will be necessary to evaluate the weldability of these materials and to develop dependable designs and welding techniques suitable for primary structural application at elevated temperatures.

Experiments conducted by the Lockheed Aircraft Corporation show that explosive piercing has good promise for making holes in these very hard materials. Our tests indicate the practicability of hot rivet upsetting of high-strength steel and titanium-alloy fasteners.

Processes and techniques are required to minimize distortion of sheets and plates during heat-treatment, and to protect the surfaces from oxidation or decarburization by means of controlled atmosphere or other techniques.

Methods for finishing and protecting these materials for service at elevated temperatures must be developed, and it is possible that clad products will be required or that anodic metal coatings, such as are being applied by vacuum deposition, will fulfill the need.

Material Requirements

The elements of the hot airplane will bear close resemblance to those of our present airplanes. This means that sheet and plate will be required in the heat-treated condition with flatness, crown, and thickness tolerances comparable with the present product. Sheet sizes from 48 in. to 72 in. wide and 35 ft or more in length may be a design requirement to preclude excessive weight penalties resulting from the additional joints required by the smaller sheets. Gages from 0.010 to 0.250 in. will be used. The tolerance on thickness will be particularly critical on these heavier materials, since it will contribute a comparatively greater weight penalty than for aluminum. Plate stock and extrusions must be processed to minimize residual stresses which would result in unacceptable distortion during machining. This problem is especially troublesome on large extrusions such as those used for spar caps and plates which are machined to provide integral stiffening. Forgings will find general usage in the hot airplane, and it will be necessary to develop equipment and techniques for producing large intricate shapes with little or no draft.

The functional systems are heavily dependent on use of nonmetallic materials. The problem of increased temperature resistance applies to most of the nonmetallic materials used in current airplanes. Time does not permit a review of the many problems to be encountered in this field. However, it will suffice to point out that plastics for transparent enclosures, elastomers for fuel and oil sealants and for tires and flexible fuel cells, reinforced plastics for radomes, and polymers for paints and insulating materials, represent formidable development needs. Fig 4 illustrates the general temperature limitations for various materials in most common aircraft use, including many of the nonmetallic items which may impose a ceiling on performance of the future airplane.

Summary and Conclusions

1 Use of the currently available heat-resisting materials will impose a serious penalty on structural weight and gross weight of the high-performance supersonic aircraft.

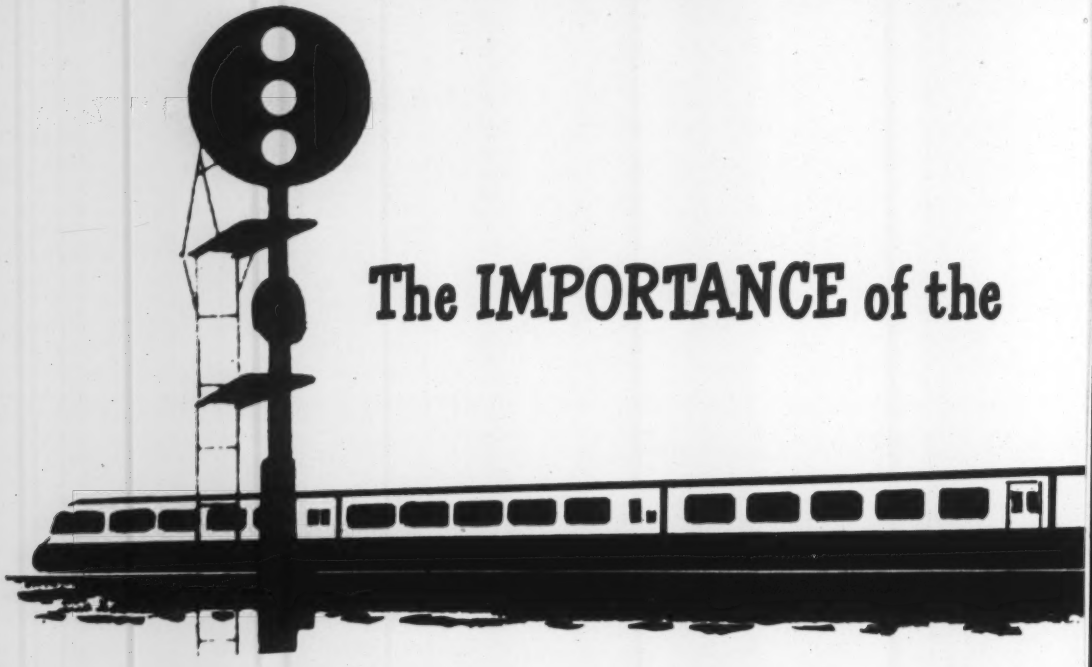
2 High-strength heat-resisting titanium alloys and corrosion-resisting steel alloys now in development show promise of ameliorating the weight situation.

3 Fabrication of the heat-resisting alloys will increase the fabricators' production costs and difficulties, and it is important that new fabrication and processing techniques be developed to offset these problems and to minimize cost of airplane construction.

4 In most cases the need for large sizes, close tolerances, and dimensional precision will be more critical in the heat-resisting materials than for aluminum because of the relatively greater weight penalty involved for excess material.

5 Present temperature limitations of some of the nonmetallic materials pose critical development requirements to satisfy needs of the functional systems.

The development of essential new materials, fabrication methods, and processing procedures is dependent upon the continued support of government-sponsored research and the ingenuity of free enterprise in industry. A co-ordinated and scheduled effort on the part of the government, the aircraft industry, and material suppliers will be required to realize the objectives within reasonable limits of time and cost.



The IMPORTANCE of the

ALTHOUGH the first contribution of the mechanical engineer to the railroad industry was the invention of the wheel—an event antedating the founding of The American Society of Mechanical Engineers by many thousands of years—he has been indispensable to the railroad industry since the development of the steam locomotive. His role has been changed somewhat by the introduction of the diesel engine, but by no means lessened.

During the era of the steam locomotive, mechanical engineers on practically every major railroad had their own ideas on locomotive design. In many cases these were dictated by particular operating conditions and problems. Nevertheless, the general nonstandardization of steam locomotives was one of the contributing factors to their decline. Diesel locomotives were produced in standard designs, and by utilizing multiple units of standard equipment, the needs of various railroads could be readily met. This achievement has given the railroads a more flexible type of motive power than was possible with the steam locomotive and, from an operation standpoint, has produced a vast improvement in the distribution and handling of power.

Economy in fuel consumption is one of the principal advantages of the diesel. Compared to an oil-burning steam locomotive, the equivalent diesel engine consumes only about one quarter the fuel in freight service, about one-third in passenger service, and about one tenth in switching service. This has eliminated the frequent stops for fuel and water necessary with steam power and has speeded up the general operation of railroad service. The characteristics of electric traction have improved tractive effort, and have reduced problems resulting from the necessity of counterbalancing driving wheels on locomotives. The diesel locomotive also requires less maintenance, and the increased availability results in greater earning power.

Based on an address delivered at the Railroad Luncheon under the auspices of the ASME Railroad Division, San Francisco Section, and Pacific Railway Club, at the Semi-Annual Meeting, San Francisco, Calif., June 9-14, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Passenger and Freight-Car Equipment

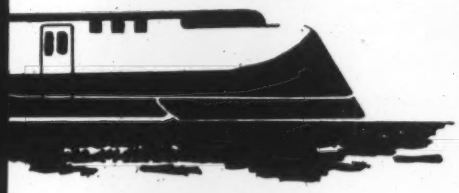
In the other phase of mechanical engineering activities on the railroads, namely the development of passenger and freight-car equipment, outstanding improvements have also been made. The original passenger cars were adapted from horse-drawn carriages with passengers riding inside and on top of such vehicles. Through the years, the modern streamlined air-conditioned passenger train has evolved. These cars represent the combined efforts of many specialists in the mechanical engineering field. The steel wheels used are of selected chemical composition and heat-treatment to provide maximum safety; the trucks involve the talents of many specialized mechanical engineers such as those concerned with roller-bearing design, spring arrangements, and cast-steel frames. In the car itself, structural design and metallurgy are of prime importance in providing the best combination of the two. Air-conditioning equipment on each individual car involves many details such as independent engines, air controls, and ducting arrangements. Air-brake equipment must be provided to insure safe operation and stopping of cars.

In the case of freight equipment, the original vehicles were again adaptations of horse-drawn equipment and carried only a few tons of freight covered with a tarpaulin. Most modern freight cars now have a capacity of 50 tons or more with some special cars carrying up to 250 tons on 32 wheels. Many different types of equipment have been designed or outfitted to handle special commodities and requirements of shippers. These include covered hoppers, insulated boxcars, mechanically refrigerated cars, auto-loaders, damage-free "DF" cars, compartmentizers, bulkhead flatcars, and special flatcars to handle trailers, commonly referred to as "piggyback" cars.

Future Mechanical Engineering Developments

When looking at modern locomotive and car equipment, one might ask, "What future developments in the mechanical engineering field are possible on the

Mechanical Engineer to the Railroad Industry



By J. W. Corbett

Vice-President, System Operations,
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railroads?" The answer is self-evident. About the only thing static on the railroad is the gage of the track. Modern railroading is a dynamic industry faced with the challenges of competition and the needs of the rapidly expanding economy.

As the Red Queen said to Alice in "Through the Looking Glass," as they raced across the chessboard land, "it takes all the running you can do to keep in the same place. If you want to get somewhere else you must run at least twice as fast as that." Similarly the railroads must utilize technological advances as fast as they can to keep up with competition and must continually be looking forward to further advances to improve their position.

Railroad Research

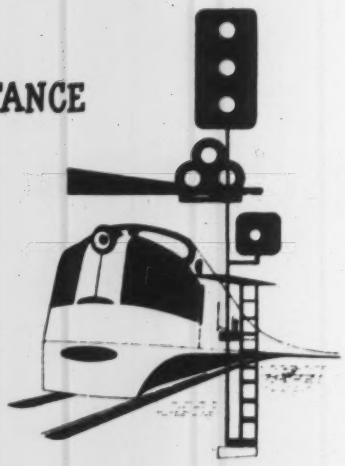
Not too many years ago organized research by industry was more the exception than the rule. The usual question asked by management was, "Can we really afford to do research?" Thanks to the impetus given to research efforts during World War II, this picture has completely changed, and the question now being asked by management is, "Can we afford *not* to do research?" Research has come to be regarded as insurance against the future.

In the mechanical engineering field, the Association of American Railroads maintains a Central Research Laboratory on the campus of the Illinois Institute of Technology in Chicago. This modern facility, headed by Directors of Mechanical and Engineering Research, serves as the hub for the research activities of the Association, which are supplemented by facilities on individual railroads.

The railroads themselves constitute a great research laboratory 220,000 miles long which serves as a proving ground for evaluating improvements in plant and equipment as well as in methods and services. Tests extend to all types of improvements, including microwave transmission, automatic data processing, radar-controlled retarder yards, centralized traffic control, piggy-back freight handling, as well as engineering.

What does the future in railroading hold for the mechanical engineer in particular? First, the ultimate goal in motive power design probably has not been realized. This is evident by the continual search for improvements in locomotives, including certain types currently under test. For example, the gas-turbine locomotive is in limited use on one major railroad, and diesel engines with direct hydraulic drive are under test. One of the major engine builders is developing a free-piston gasifier to drive a gas turbine for locomotive use. The Association of American Railroads has a standing committee on atomic energy for the purpose of investigating the feasibility of nuclear power for locomotive use, either by means of a reactor aboard the locomotive unit, or by transmitted electrical energy generated at a central nuclear power plant. The field of future development in locomotive design is wide open. With the diesel engine we can say that we have reached a plateau in the evolution of railroad motive power but have by no means achieved the summit.

A problem of major concern to the railroad industry is the future of our energy resources, particularly in the West. Southern Pacific has sponsored a program at Stanford Research Institute to develop the best available information of future sources of energy in the area served by the Company. The railroads are a major consumer of distillate fuel produced from petroleum. The increasing use of jet engines both in military and commercial airplanes, and other nonrailroad demands for refined products have caused us concern as to the availability of distillate fuels, particularly in a national emergency. Here is another challenge for the engineer to design and develop equipment which will permit utilization of a wider range of fuel. Broadening of fuel requirements for a major consumer such as railroads will not only offer economies to the purchase but will also permit the oil suppliers to have greater flexibility in meeting civilian and military demands. Realizing this, Southern Pacific Company has for the past four years devoted a major portion of its mechanical research effort to the utilization of less critical fuels in



diesel locomotives. From this effort has developed the dual-fuel system utilizing distillate fuel for starting, idling, and low outputs, and less costly fuel for high outputs when such fuels can be satisfactorily consumed.

Passenger and Freight-Car Design

Turning to the problems of passenger-car design, we have seen in the past few years evidences of the shape of things to come. Dome cars have been introduced by many railroads to provide an additional attraction for the traveling public. Experimental coaches with passengers riding at an elevated level are in use on a major railroad. Several novel innovations in lightweight train design have made their appearance to incorporate forward thinking on the part of car builders. Among new ideas introduced are air-cushioned springs, prefabricated plastic interiors, composition brake shoes, close-coupled bodies, and lower centers of gravity to permit higher speeds on curves. Many of you are familiar with the two-level suburban cars placed in service by the Southern Pacific on the peninsula run. These cars, besides providing additional passenger comforts, have made possible a greater passenger-carrying capacity per car necessitated by the conditions of this service.

In the field of freight-car design, we can also look forward to major changes, improvements, and the elimination of mechanical difficulties which plague us today, such as the hotbox and impact-damage problems. A concerted effort is being made to eliminate the former problem, but the adequate protection of lading in freight cars demands attention. The draft gears or shock absorbers installed behind the couplers do not in all cases provide this protection, particularly where severe impacts are encountered. There is a growing need for an improved method of shock absorption for freight-car equipment when handling commodities susceptible to impact damage. Southern Pacific has made a contribution to this cause by the development of the so-called hydracushion underframe. This device, which was developed by our mechanical engineers working co-operatively with those at Stanford Research Institute, operates on a hydraulic-friction principle. Freight cars so equipped are provided with a sliding center sill having a coupler and conventional draft gear at each end. The increased shock absorption is obtained by the use of a stack of friction plates alternately secured to the fixed frame and to the sliding sill. A hydraulic piston under the stack of plates is actuated by the movement of the sliding sill and compresses the plates in proportion to the speed and severity of impact. The shock absorption is effectively accomplished, without undesirable recoil, by the frictional resistance between the fixed and sliding plates under the pressure from the hydraulic piston. Carefully instrumented tests have indicated that cars equipped with the hydracushion underframe can reduce the severity of a 10-mph impact at the coupler to less than a 4-mph impact inside the car. This reduced level of impact to the car-body lading is effective in preventing damage. Experimental cars of the hydracushion design have been in service, handling such fragile commodities as stem glassware, tile, and curved automobile glass. The latter commodity presents a particularly severe problem in handling due to the curved contours of the glass. Whereas this lading caused substantial damage claims when handled in conventional cars, not a single piece of glass has yet been broken in hydracushion cars. Within the next few months, Southern Pacific will build an additional 349 boxcars equipped with the hydracushion underframe.

This particular development has been explained at some length because it is a good example of the application of modern mechanical engineering principles to a railroad problem. It is only one of many current problems that can be solved by proper application of these principles to equipment design.

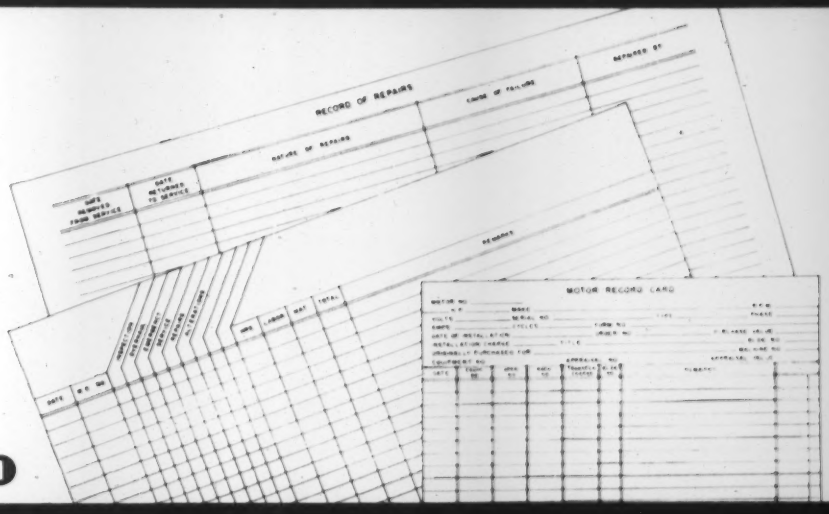
Contributions of Other Engineering Fields

While the contributions of mechanical engineers are the topic of this paper, a few developments in other fields of engineering should be mentioned.

In the civil engineering field, an outstand ng example of progressive railroading is the replacement of the world's longest railroad trestle, in use since 1904, with a $49-million 13-mile rock-armored fill across the Great Salt Lake.

In the communications engineering field, we have made great strides. Radio communications between locomotive cabs, cabooses, and terminals have greatly speeded up operations. A system-wide dial-telephone service has improved the efficiency of our intercompany communications. Microwave or beamed line-of-sight radio is taking over along stretches of rugged mountain country to make communications safer than ever against winter-weather hazards.

In the electronic and electrical engineering fields we are utilizing radar-controlled retarder yards and centralized traffic-control systems. We are experimenting with electronic hotbox detectors which can pick out an overheated journal as the train rolls by. We are finding ever-increasing uses for electronic computers and data-processing equipment to speed up our everyday work. We are using the electron microscope at our laboratory as well as ultrasonic beams and radioactive isotopes to search for defects and flaws in wheels and axles, and other forgings and castings. In short, we are taking advantage of the latest tools made available by modern science and technology. By all of these means engineers are contributing to the improvement of our position in the competitive field of transportation.



With the development of continuously operated integrated processes, the effects of component reliability have become considerably more significant. Means are available for accumulating adequate data on equipment component performance to permit systematic analysis of the maintenance problems, and the use of equipment to facilitate correction of these problems.

Developments in the Analysis of MAINTENANCE PROBLEMS

By J. D. Quinn,[1]
Mem. ASME

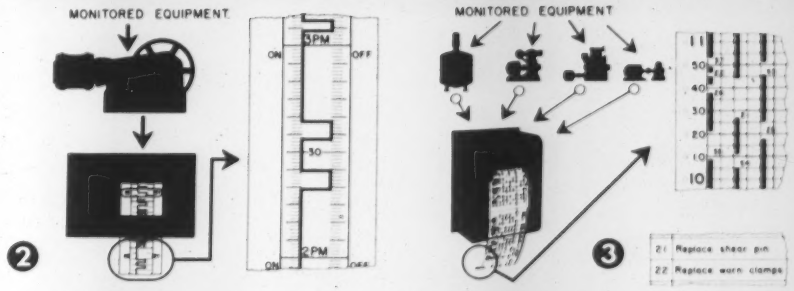


Fig. 1 Equipment-history cards provide a means of analyzing the maintenance performed on various units of equipment

Fig. 2 Time-recording and totalizing equipment indicates the number of shutdowns and length of intervals, and space is provided for recording reasons

Fig. 3 Multichannel recorders permit performance recording of 20 or more units. A numerical code identifies the reason for down time, transmitted and imprinted on the chart through the use of a conventional telephone dial located at each of the operating units.

A MODERN concept of maintenance should recognize the rapidly changing character and requirements of industrial plants. Many processes have developed from batch operations to practically integrated operations, and then to highly integrated continuous systems. With these changes, the need for more effective maintenance and assured component reliability has become mandatory. Much has been done to improve the effectiveness of maintenance work through improved planning and scheduling, but there should be more concern about the reasons why the work is being performed. While it is a decided advantage to complete a repair job in two hours that formerly required four, it would be a more significant improvement to eliminate the work altogether.

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Data for Correction of Maintenance Problems

In recent years, considerable thought has been given to the problem of accumulating sufficient data to allow the study of maintenance problems in terms of production losses, cost of maintenance, and justification of improvements.

Many plants have designed accounting systems to provide cost information that would indicate trends in maintenance conditions, often by unit cost related to a product, or by investment areas. Some plants have designed accounting systems to provide maintenance cost by units of equipment, in order to determine whether the cost of maintenance is reasonable or excessive in relation to installed cost. This can be misleading if it is not allocated to components. While, for example, $600 may consitute only 5 per cent of the value of an entire machine, if $500 of it was spent on a single component, the annual maintenance cost is 50 per cent of the value of that unit rather than 5 per cent.

While accounting methods can indicate the area of the problem, they do not provide answers regarding type and frequency. Equipment-history cards similar to those in Fig. 1 have been adopted by many industrial plants for the entry of maintenance performed on the various units of equipment. Because of the clerical effort involved, the entries usually are limited to the major work, but this does not provide information about the repetitious minor items which can be even more important. It has been found that minor maintenance jobs requiring less than 2 man-hours of labor, and moderate material expenditures can amount to 25 to 35 per cent of the total maintenance cost.

The clerical work necessary to record minor work cannot be justified. However, there appear to be two possible approaches. One involves preparation of orders for both major and minor repairs, and then filing of the completed orders directly by units of equipment without posting detailed records. With this, the accounting system can indicate the cost by units of equipment, and the order file can provide information concerning the type and frequency of work performed.

Another means of accumulating data that appears to have high potential is the adaptation of recording equipment developed primarily for production control. If only a record of equipment down time is required, an electric clock installed in the equipment circuit will tell how much time is lost, but not when or why the equipment was shut down. The time-recording and totalizing equipment shown in Fig. 2 will indicate the number of shutdowns and length of intervals, and provides space on the time strip to record reasons. This type of recording device has application for accumulating data but only for an individual unit.

When the operation of a considerable number of units is to be studied simultaneously, equipment is available that permits the performance recording of 20 or more units which may be located a half mile or more from the central recorder. This allows recording of critical or key equipment performance at various points in the system. Shown in Fig. 3 is a type of multichannel time-strip recorder which can be adapted for this purpose. When the process or auxiliary equipment is operating, the line on the chart is continuous. When the equipment is not operating, the line is interrupted, and a reason can be supplied by an operator or mechanic. Numerical codes, such as those shown, identify the reason for down time and can be transmitted and imprinted on the chart. This is accomplished through the use of a conventional telephone dial located at each of the operating units. The recording system can be modified to provide one, two, or three-digit codes or up to a total of one thousand specific reasons why the monitored equipment was not operating.

In the use of the recording equipment, there is an added advantage over the repair-order system in that the code used indicates precisely what was done rather than what the problem was thought to be. While the system depends on the operator or mechanic to provide these reasons for equipment down time, failures to report the reasons can be kept to a minimum. In one case where over 6000 short-interval shutdowns were recorded each week, the unreported reasons represented less than 2 per cent of the total down time. There is no limit to the amount of detailed data that can be obtained, but there is an economical limit to the amount of manual recapitulation for analysis that can be considered. This limit is not normally reached, but recapitulation can be done automatically by other equipment recently developed which records the data on punched-paper teletype tape. The taped data can be put into an electronic digital computer and processed to identify important problems and their effect.

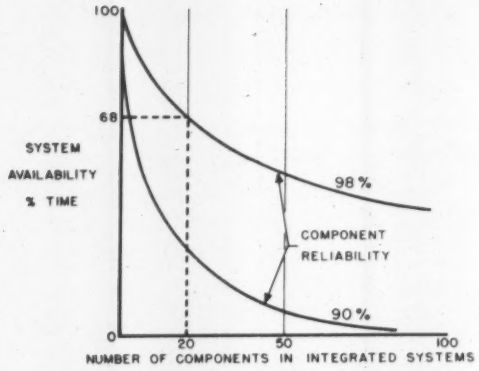

Fig. 4 Effect of failures is related to reliability and number of components

Analysis of Data

Detailed information becomes extremely important in integrated systems having a considerable number of components. In these systems, the need exists for high component reliability since the effect of component failures becomes cumulative. For example, if we have two components in a system, each having 90 per cent reliability, then the system reliability could be the product of 90 × 90, or 81 per cent.

Fig. 4 shows curves that have been developed to indicate the effect of component reliability for various numbers of components and the over-all effect on system reliability. The example indicated by the dotted lines, showing 20 components having reliability of 98 per cent, results in system reliability which could be about 68 per cent of the available operating time. This indicates the importance of improving the reliability of individual components.

When the frequency of component failure has been established, then the general pattern of the failure should be considered. To establish the pattern of failures, which in many cases will indicate the course of study to be considered, mechanical-failure curves can be developed. In Fig. 5 there are two such curves. The three parts of curve A on the right have been classified as infant mortality, random failures, and wear-out. These are plotted to indicate the probability of failure versus elapsed operating time. The three sections indicate the type of failure and effect.

Infant mortality, which is considered as the area below the point where the curve breaks, would indicate faulty repair or replacement procedures, or faulty components. The problem is usually related to quality of installation workmanship. The correction in this case could be study of the maintenance work performed, development of detailed procedures, and training of the mechanics in the use of the procedures.

If it is found that the problem is quality of components rather than workmanship, then preservice testing can be designed to study causes of infant mortality.

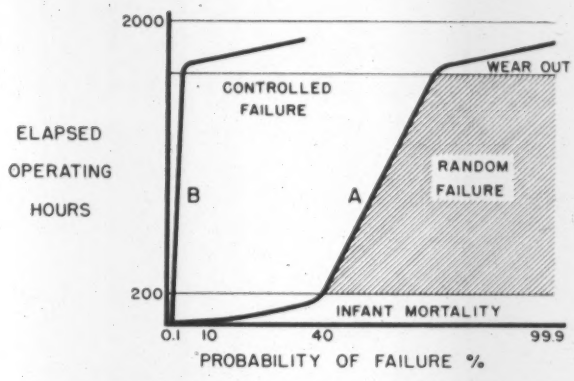

Fig. 5 Mechanical failure curves can be developed, once the frequency of component failures has been established

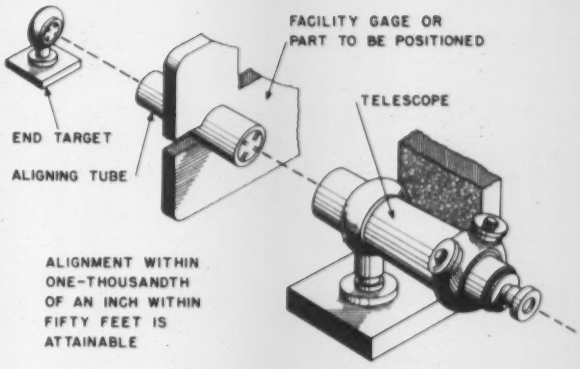

Fig. 6 Optical tooling, used extensively in the aircraft industry, permits precise alignment of equipment

Random failures indicate a situation that could be classified as "out of control." This could be the result of varying operating conditions such as increased loads or the effect of other production changes. The situation requires study to isolate the significant parameters.

If it is found that wear-out occurs considerably below the designed or expected life of the equipment, then operating conditions should be examined. The cause may be a product change, increased speed, or loading. If the operating conditions must be accepted, then redesign to meet the conditions may be necessary.

Curve B indicates the conditions that could result through reduction of infant mortality and random failures, and could be considered an ideal situation. If wear-out is occurring within a reasonable range of the designed or expected life, then redesign or alternate materials should be considered to extend the period of service.

Equipment for Correction of Problems

Occasionally, lack of adequate tooling for accurate installation produces a maintenance problem. In an investigation of premature failures of mechanical seals it was shown that the mechanics were quite familiar with the installation requirements but that the tooling provided was inadequate. A very simple fixture was designed to allow a dial indicator to be used for the alignment of such seals, and the difficulty disappeared. Optical tooling, developed in Europe, has been used extensively by the aircraft industry for alignment problems in the installation of equipment, and is now being manufactured in the United States. There appears to be a considerable range of application for this equipment within the process industries. Fig. 6 shows a set of instruments consisting of (*a*) a special telescope with micrometer adjustments for positioning; (*b*) a section to be aligned; (*c*) the alignment tube; and (*d*) an illuminated target. With this equipment, alignment within 0.001 in. in 50 ft is attainable.

With jigs and facility gages the equipment is adaptable for shop use during the fabrication of large units requiring close tolerances. In addition to maintenance, field, and shop applications, when new units are being installed, a permanent installation of the telescope and target-mounting brackets can be made which will allow the original base line to be re-established readily.

Another condition that often requires correction is vibration resulting from unbalance of rotating parts. Portable vibration analyzers are being utilized for this purpose which permit in-place static or dynamic balancing of rotating equipment.

In the new plant, or following installation of new equipment in an existing plant, a systematic check of all critical rotating equipment can aid considerably in attaining satisfactory performance. It will provide reference readings of the "as-installed" state; it will insure that the equipment is in acceptable condition; or, it will permit correction prior to placing the equipment in service. Periodic checking of equipment already in service can be considered to insure that equipment performance remains satisfactory. Through the use of this equipment a substantial improvement in component reliability can be realized.

Summary

In summary, a combination of techniques and equipment is essential to the improvement of component reliability in modern plants. The solution of maintenance problems is not a requirement that has developed recently, but, with the development of modern industry, the requirements have become much more demanding. The days of "fire fighting" in maintenance are rapidly passing, but we cannot be complacent about preventive maintenance either. We may be performing work conscientiously that better analysis would prove unnecessary.

A logical approach leading to an optimum balance between excessive emergency maintenance and excessive preventive maintenance, includes:

1 A systematic means of procuring background data concerning equipment repairs, their cause and effects.

2 An organized plan for the solution of problems which includes assignment of personnel to the program, and periodic reporting of the program to establish justification and priority for studies.

3 Accumulation of sufficient data to evaluate improvements being considered and, later, to establish the effect of the improvements and the benefits of the over-all program.

Through this approach, the justification of engineering time for problem solution can be established. Problem solution, or corrective maintenance, can be considered as a business proposition that shows an excellent return on the expenditure, and results in a significant contribution to the production of a quality product at a lower cost.

By C. M. Marquardt

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Salt Lake City, Utah

Weighing and Blending with PNEUMATIC BELT SCALES

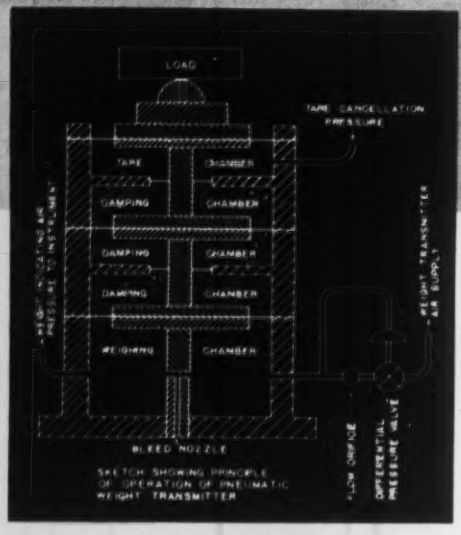

Fig. 1 The pneumatic weight transmitter is constructed of a series of chambers with flexible diaphragms between. A constant flow of air enters the lower chamber. If there is an increase in weight, the central shaft closes the bleed-nozzle port and pressure builds up until air again escapes. The pressure is measured and converted to weight.

Pneumatic Weight Transmitter or Load Cell

THE heart of the new pneumatic conveyer weighing system is the pneumatic load cell which is constructed of a series of chambers with flexible diaphragms between them.

Weight is applied to the central shaft of the load cell to which the diaphragms are connected. Air at approximately 25 psi is brought to the lower chamber. The air flows through an orifice with a differential pressure regulator which maintains a constant pressure drop across the orifice. It follows from fundamental physics that the flow of air will be constant at all times.

Air escapes from this chamber through a bleed nozzle, the opening of which is controlled by the weight on the central shaft of the weight transmitter.

If there is an increase in weight on the load cell the central shaft then closes the bleed-nozzle port, but in the meantime air continues to flow into the weighing chamber at a constant rate as just mentioned. The pressure in the weighing chamber builds up quickly to a point where air again escapes through the bleed nozzle. The air pressure developed in the weigh chamber is transmitted to a standard-process pneumatic receiver, which indicates, or records, the weight on the load cell.

Inversely, if the weight on the load cell decreases, the central shaft moves away from the bleed-nozzle port and allows air to escape more rapidly, and thus reduces the pressure in the weigh chamber.

Thus mechanical force or weight on the load cell is converted to an air-pressure signal which may be measured using a standard-process air-receiver instrument. The total movement of the diaphragms from zero load to full load does not exceed 0.010 in. The reaction of the load cell to changes in weight is extremely rapid, the scale being able to go from zero load to full load in less than 1 sec.

Eliminating Effects of Tare Weight

A unique feature of the load cell is the means used for eliminating the effects of tare weight. The top chamber of the load cell is the tare chamber. To eliminate tare weight on the scale, air at an adjustable but thereafter constantly maintained pressure is brought into this chamber. Here it exerts pressure upward to eliminate tare weight without the added friction and consequent inaccuracy usually associated with tare-compensating devices.

Damping chambers are another feature of the pneumatic weighing system. These are used for the purpose of eliminating, almost entirely, minor extraneous vibrations that may affect the weighing system. Position of the load cell is also unimportant as long as the force on the cell is along the central cell rod.

The pneumatic load cells are accurate to 0.1 per cent of full scale. They have a sensitivity of one part in 5000, and are constructed in 22 sizes for weighing full-load weights of as small as 50 lb to as great as 25,000 lb.

The Scale Weigh Section

No knife edges or hanging rods are needed when employing a pneumatic load cell with a conveyer. A weigh section is constructed under the belt and bolted to the conveyer-assembly stringers. In lieu of the knife edges, self-aligning pillow-block ball bearings are employed, which firmly fix the light but rigid weigh section in position and form a practically friction-free fulcrum system for the weigh section.

Only forces that are perpendicular to the direction of travel of the belt, and not torsional stresses, are transmitted to the load cell.

With the pneumatic conveyer scales, the solution of the problem of changes in belt speed resulting from changes in load, which affect the integrated tonnage, is

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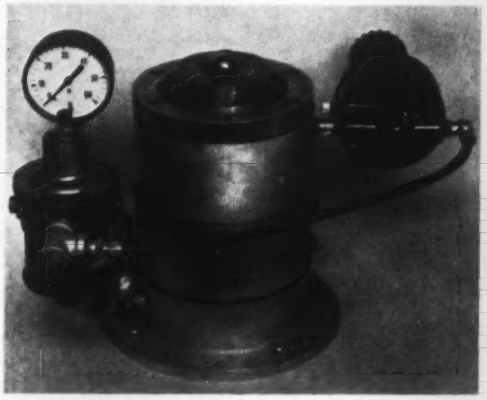

Fig. 2 The typical pneumatic load cell can be used under a great variety of conditions, since it is tare-compensating

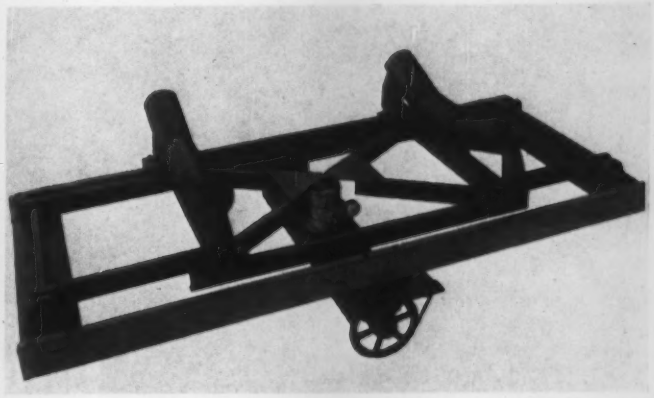

Fig. 3 Weigh-section construction utilizes the pneumatic load cell, *center*, as a conveyer scale. Only perpendicular forces can be transmitted.

accomplished in a unique manner. A tachometer generator coupled to the return portion of the belt synchronizes the speed of belt movement with the frequency of sample weighing.

The tachometer generator employed is an 8-pole permanent-magnet machine which develops exactly 60 cycles when driven at a speed of 900 rpm. As the belt slows down, so does the frequency, as the belt speeds up, the frequency increases, giving a very precise measure of the speed of the belt. Therefore, by merely inserting a power amplifier between the tachometer and the synchronous counter motor, to amplify the tachometer signal, belt speed is compensated for with absolute accuracy.

Installation and Operation of Conveyer Belt Scales

The recording and integrating instruments may be located at any convenient location up to 400 ft from the weigh section—in an office, if desired. Available plant air down to as low as 40 psi may be employed. The system consumes approximately 2 cfm. An instrument filter removes water and other contaminants from the air. The instrument is connected to the load cell with either copper or plastic tubing.

The tare-adjustment pressure regulator, an ordinary precision instrument regulator, located in the scale panel, is adjusted to make the recorder read zero when there is no load on the belt.

A location for the scales permitting a considerable length of belt to rest on the weigh section is very important. A 6-ft weigh length is a normal minimum, with an 8-ft weigh section preferred, and a 12-ft weigh section recommended for some applications.

The weigh section should be far enough from the belt-point to avoid the effects of loading impact. Also a sufficient sample is necessary for accurate weighing. If the normal weight per foot of belt is too low for accurate weighing, reducing the belt speed will increase the weight per foot of belt. An extremely flexible belt will also improve accuracy. Nylon-filled belts are among the best.

The inclination of the conveyer belt is unimportant. The pneumatic system will weigh equally as well on an elevating belt as on a descending belt.

The application of control is a straightforward use of process-control instrumentation.

Geneva Works Installation

The system employed at the Geneva Works, Columbia-Geneva Steel Division of the United States Steel Corporation, Geneva, Utah, is one of the more difficult, yet typical applications.

Four different coals are blended into a single product resulting in an improved metallurgical grade of coke.

The coal is stored in four rectangular bins immediately above the blending room and is admitted to four blending belts through inclined chutes.

The problem was a particularly difficult one. There were serious space limitations, existing equipment had to be maintained while the new equipment was being installed, and the system had to be flexible over a very wide range of conditions.

An accuracy of 1 per cent over the range from 25 tons per hr to 400 tons per hr was desired on each belt. To obtain accuracy at the low tonnage rate the blending belts are operated at four discrete constant speeds of 40, 80, 120, and 160 fpm, respectively. At 40 fpm, the fully loaded scale will deliver 100 tons per hr; at 80 fpm, 200 tons per hr; at 120 fpm, 300 tons per hr; and at 160 fpm, the fully loaded scale will deliver 400 tons per hr. Thus at 50 tons per hr the scale is as fully loaded, when the blending belt is running at 40 fpm, as it would be when delivering 100 tons per hr with the blending belt operating at 80 fpm.

Tachometer generators and electronic potentiometers equipped with conventional pneumatic controllers produce a pneumatic signal to control the speed of the four Link-Belt PIV drives operating the respective blending belts to a high degree of accuracy.

Because of the cramped conditions, a suspended weigh-section is employed, and the skirt boards are a part of the tare weight of the section.

The weight signal from a preselected blending belt scale is selected as the master for the system, and also transmits a signal to operate the control gate for maintaining a constant weight on its scale.

The total tonnage delivered by the blending system may be varied at any time merely by changing the position of the control index of the master controller. The other three slave controllers are forced to maintain a precise ratio with respect to the master at all times.

This system represents a considerable departure from conventional weighing practice, and the innovations employed to solve this difficult problem are an excellent example of how versatile pneumatic weighing is when conventional process-control instruments can be employed. There appears to be practically no limit to the innovations that can be employed. It is possible to ratio water or other fluids to a master.

BACK EXTRUSION OF HEAVY-

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AT THE Westinghouse Atomic Power Division, Materials Development required quantities of heavy-walled Zircaloy-2 cups, Fig. 1. Because the bar stock of this alloy[1] costs $25 per lb, and because remelted machine scrap is not usable in nuclear reactors (its corrosion resistance is lowered due to contamination), it was out of the question to machine a large quantity of these components.

Back Extrusion

Back extrusion was decided on as the practical method of production. Several concerns participated in the early development work, all using vertical presses with a pot-and-punch die, Zircaloy-2 stock being forced to flow upward around the punch to form the cup. Three techniques were tried: Back extrusion using glass as a lubricant; back extrusion using copper as lubricant; and impact back extrusion of both bare and copper-jacketed billets.

Glass as a Lubricant. Two types of Zircaloy-2 billets were used for development work in which glass was the lubricant: round, and round-cornered square. The unclad billets, $2^{9}/_{16}$-in. diam × 4 in. high, were heated in a barium-chloride salt bath to three temperatures, 1800 F, 1850 F, and 1900 F for 20 min. Prior to placing the heated billet in the die, several disks of fiberglas were placed in the bottom of the die and on top of the billet. The die and punch were preheated to about 600 F. Fig. 2 shows three punches that were tried. Fig. 3 shows a cup resulting from punch B.

The round-cornered-square billets were used to allow some lateral flow in addition to the upward flow of metal, thus reducing friction and producing a smoother sidewall; also, the heat loss from billet to die would be reduced because the contact area would be less and the salt would be more apt to remain liquid and aid lubrication. Striations on the ID of the cups were avoided by removing the metal pickup from the punch after each extrusion. At 1900 F, extrusion loads did not exceed 40 tons.

This method produced successful cups. To allow sufficient stock for machining to final dimensions, the vendor recommended allowances of $^{1}/_{16}$ in. at ID, OD, and sidewall thickness, and $^{5}/_{8}$ in. for sidewall length.

Copper as a Lubricant. A group of 50 billets, 2.480-in. diam × 2 in. long, was copper jacketed, Fig. 4. Six of the billets were extruded at 1600 F, but the surfaces were badly torn because of the alloying of the Zircaloy-2 and the copper. The temperature was reduced to 1400 F, and the remainder of the billets were successfully extruded. Fig. 5 shows vertical sections of typical cups produced in this manner.

Impact Extrusion. Eighteen copper-jacketed and six bare billets, 2.66-in. diam × 2.51 in. long, were fabricated into cups by impact extrusion. The copper-jacketed billets were extruded at temperatures ranging from 800 F to 1400 F. All extruded easily, with the exception of the one extruded at 800 F, and this one was badly torn. The tooling was in excellent condition after the extrusion of 18 copper-jacketed billets. The surfaces of the cups were found to be good, with an orange-peel appearance after copper removal; dimensionally, the cups were satisfactory.

The bare billets were extruded at temperatures ranging from 1400 F to 1800 F. None produced a satisfactory cup, as the outside surface had innumerable small tears and the inner surfaces were badly scored. After the sixth unjacketed extrusion, the tooling was unfit for further use. The surfaces of the nonjacketed cups extruded at the lower temperatures were better than those extruded at the higher temperatures, probably because Zircaloy-2 is more plastic at the higher temperatures and would tend to tear more easily with the same amount of die friction.

The Horizontal Press

A fast-acting vertical press was not available in the authors' laboratory, and when exigencies arose it was

[1] Zircaloy-2 is a zirconium-base alloy with nominal composition of 1.45 per cent Sn, 0.12 per cent Fe, 0.10 per cent Cr, and 0.05 per cent Ni.

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WALLED ZIRCALOY-2 CUPS

necessary to produce cups on a 500-ton horizontal extrusion press. Several problems arose concerning lubrication, removal of the cup from the stem, and concentricity deviation.

Billets were jacketed with $^1/_{32}$-in-thick copper on the sides and bottom, and $^1/_8$-in-thick copper on the top. Fig. 6 shows the setup. Successful extrusions were made at temperatures from 1085 F to 1700 F, with extrusion loads not exceeding 120 tons.

Because of the success of the initial attempts, the production of cups proceeded. The existing container being used was somewhat oversize and caused a large loss of Zircaloy-2 when machining the OD of the cups to the required size. However, it was felt that this loss could be reduced considerably by using a heavy copper jacket (0.15 in. thick) to fill the excess space. The billets were heated for 15 min in carbonate salt bath at 1400 F prior to extrusion. When the cups were dejacketed, an annular ring was found at the bottom of each one, attributed to the bottom of the Zircaloy-2 flowing up the sidewall in the softer copper.

It was quite evident that the thick copper jacketing was undesirable. To overcome the difficulties encountered, a new press container liner was installed, permit-

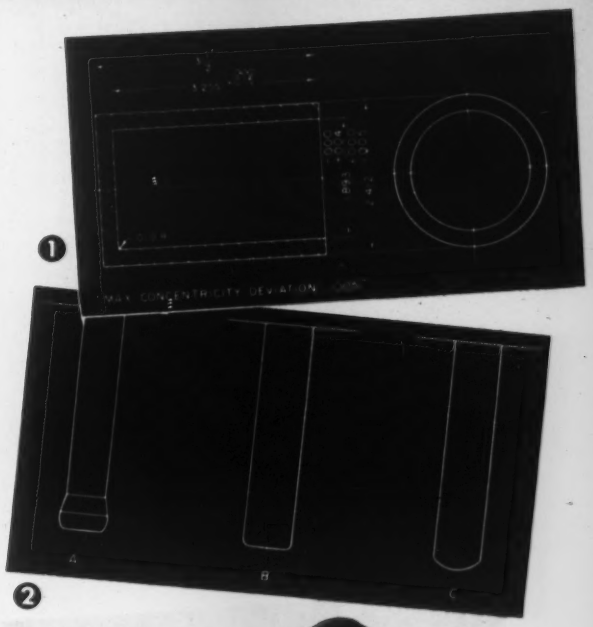

Fig. 1 The finished Zircaloy-2 cup. Back extrusion, as the production method, produced a cup that required only minor machining. It permitted fast deliveries, and was suitable for the production of small quantities.

Fig. 2 Types of punches. Type A proved unsuccessful, because the stock flowed into the reduced section behind the nose during withdrawal. Punch B solved this problem. Punch C was later tried in the belief that better metal flow would result, but experience did not bear this out.

Fig. 3 The surface of the first cups (glass lubricant) was similar to that of Zircaloy-2 forgings. Sprinkling the billets with sodium chloride and/or powdered glass failed to reduce minor roughness.

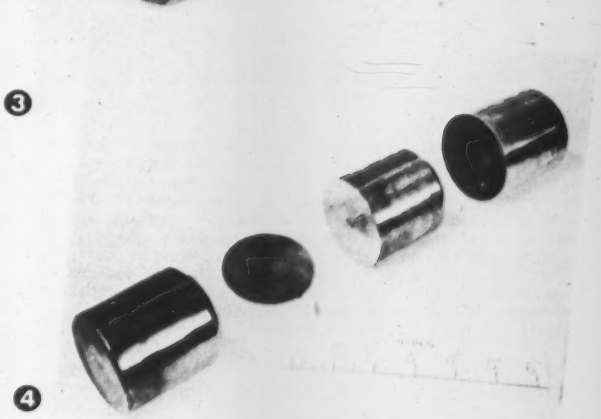

Fig. 4 Copper jacketing for Zircaloy-2. A spun-copper cup, $^1/_{32}$ in. thick, to enclose the stock, and a $^1/_8$-in. copper disk heliarc welded on top. Assembled billet at *left*, and exploded view of components.

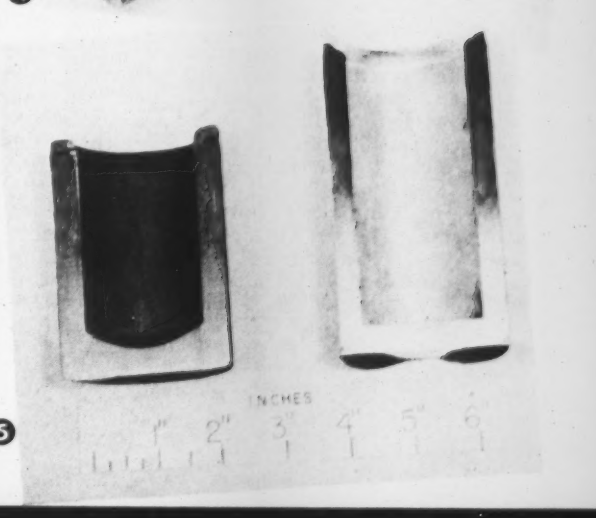

Fig. 5 Vertical sections of back-extruded cups produced from copper-jacketed billets. Copper was removed by etching in a 50 per cent HNO_3 + 50 per cent H_2O solution. Reproduction of dimensions was satisfactory.

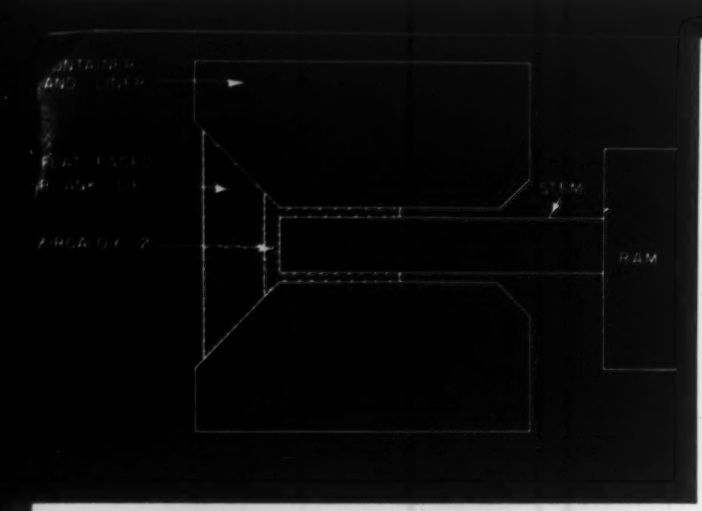

Fig. 6 Setup for producing back-extruded Zircaloy-2 cups using a horizontal press. Problems of billet size and jacketing had to be worked out, but successful extrusions were achieved, with extrusion loads of 120 tons.

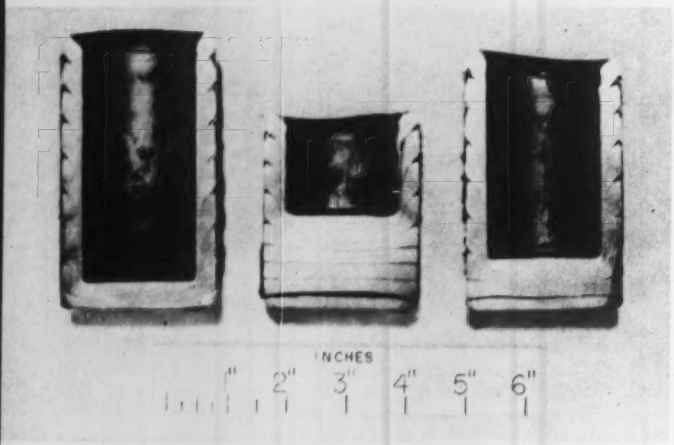

Fig. 7 The flow pattern. Flow of Zircaloy-2 during back extrusion of cups was difficult to determine in the manner ordinarily used for steel because Zircaloy-2 is difficult to microetch, the grain size is small, and insufficient impurities or second phases are present to show flow patterns. Three test assemblies were made, each of eight $^1/_4$-in-thick Zircaloy-2 disks, separated by 0.010-in. copper disks, all placed in a copper can and welded into an assembly such as that in Fig. 4. The assemblies were back extruded (fully extruded cup at *left*, and intermediate stages of extrusion at *right*). The thin copper disks show the metal flow pattern.

ting the use of $^1/_{32}$-in-thick copper on the sidewalls of the billets. The cups produced using the new equipment were satisfactory.

The extruded cups remained in the container and were removed by withdrawing the container from the die face and pushing out with a dummy block between the stem and the cup. Between extrusions the stem was cooled by a hollow, perforated collar with forced air blowing through it. The allowance of 0.060 in. on the OD and ID for machining to final size was sufficient.

It was found necessary to utilize some undersize Zircaloy-2 stock in order to conserve material and meet commitments. The first attempts proved futile because the cups were very eccentric and press adjustment did not correct the situation. The billets were then upset to a larger diam by heating for 15 min at 1400 F, placing them in the press with a dummy block in front of and behind the billet, and pressing with about 75 tons. These billets were reheated and back extruded. The cups produced were quite concentric.

Extruding the Bare Billet

The copper jacketing of billets and the dejacketing of cups are both costly and time consuming. Because the extrusion of Zircaloy-2 generally causes a great deal of galling, it was thought that bare extrusion would be difficult, if not impossible. A lubricant of Led-Plate plus molybdenum disulfide was tried. A billet was heated at 1400 F for 15 min in a carbonate salt bath, and a copper disk $^1/_8$ in. thick × $2^1/_2$-in. diam was placed between the stem and the billet, forming a copper lining in the cup. The billet extruded easily, but stuck on the stem. Several other billets also stuck.

It was noted that there were no ears on the bottom of the extruded cups. It appeared that the lubrication of the liner allowed the metal to flow backward before it flowed forward into the notches of the blank die. By eliminating the lubrication of the liner (except for the salt) it was possible to produce ears, thereby holding the cups in the container. The absence of Led-Plate plus molybdenum-disulfide lubricant did not cause any surface tearing. The lubricant was still applied to the stem. Bare extrusion caused an increase of about 15 per cent in the extrusion pressure. Eccentricity measurements gave the same range of values as obtained for copper-jacketed extrusions. The outside surface was superior to that of the jacketed extrusions. Inside surfaces, however, were slightly inferior. This was attributed to salt between the copper disk and the bare billet forming a nonuniform layer between the cup and the copper.

Summary

Both vertical and horizontal extrusion presses were used successfully to back extrude Zircaloy-2 cups. Impact extrusion of copper-jacketed billets was successful, whereas impact extrusions of bare billets were badly torn. Glass and copper have been used successfully as lubricants for billets to produce cups on a slow-acting vertical press. Copper-jacketed billets have been satisfactorily back extruded into cups, using a horizontal extrusion press; bare billets with only the salt from the heating bath as a lubricant have also been successfully produced on this type of press.

It is felt that bare billets could be back extruded on a vertical press by using some lubrication, either molten salt, or the Led-Plate plus molybdenum disulfide, and thus take advantage of the high production rates inherent in the use of the vertical press.

Acknowledgments

The authors wish to thank Scaife Company, Oakmont, Penn.; Aluminum Company of America, Edgewater, N. J.; and Wyman-Gordon Company, Worcester, Mass., for their assistance in the development of this product.

Reference

"The Metallurgy of Zirconium," by B. Lustman and F. Kerze, Jr., McGraw-Hill Book Company, Inc., New York, N. Y., 1955, pages 255–259.

This is an account of the development of a new graphical presentation of data on the thermodynamic properties of compressed light water. Enthalpy was plotted against entropy with lines of constant pressure, constant temperature, and constant specific volume. The end result was a chart[3] covering the temperature range 32 F to 705.4 F and the pressure range 0.08854 psia to 6000 psia.

THERMODYNAMIC PROPERTIES OF COMPRESSED WATER

By T. C. Tsu[1] and D. T. Beecher[2]

ADVANCES in technology, such as pressurized-water-cooled nuclear reactors and supercritical-pressure steam turbines, point up the need for an accurate and convenient presentation of the thermodynamic properties of compressed water. The authors have attempted to fill this need, though they have not used any new experimental data in constructing their chart. Uncertainties in the data still remain as the temperature comes within a few degrees of the critical point, but it seemed desirable to present the data as they now exist.

Data and Methods

Among well-known references are the tables of Keenan and Keyes (1),[4] the charts of Ellenwood and Mackey (2), and the high-pressure studies of Bridgman (3). Although these are valuable contributions available to all engineers, there are disadvantages or limitations that make it desirable to have a more detailed formulation. The Keenan and Keyes tabulation of enthalpy, entropy, and specific volume versus temperature and pressure involves rather large temperature increments, so that interpolation is not readily made. The Ellenwood and Mackey chart, using enthalpy and specific volume as co-ordinates, is of very small scale. Bridgman's data on water were obtained at relatively low temperatures, though they cover very high pressures.

For the users' convenience and to avoid numerical cross-interpolations, it was decided to present the data graphically. A search of the literature reveals that reliable data exist for the temperature range 32 F up to within a few degrees of the critical temperature, 705.4 F, and for pressures up to 6000 psia. Although Tammann and Ruehenbeck have reported data up to 1200 F and 35,000 psia (4, 5), their temperature intervals are very coarse and their accuracy has yet to be verified. Kennedy has published data up to 1832 F and 36,260 psia (6). However, his measurements are being verified and it would seem prudent to defer the use of his data until a later date. Kirillin and Rumjanzev (7) have obtained volume data up to 1112 F and 7100 psia, but their measurements were made at only six temperatures between 808 F and 1112 F. In behalf of the ASME Research Committee on Properties of Steam, Keenan and Keyes have proposed (8) to extend the temperature limit to 1500 F (800 C) and the pressure limit to 15,000 psia (1000 atm) through an international program of co-operative research.

It was decided that the properties to be presented should include temperature (t), pressure (p), specific volume (v), enthalpy (h), and entropy (s). The transport properties, viscosity, and thermal conductivity, although equally important, are intentionally omitted because they have not been measured to a degree of accuracy comparable to that of the equilibrium properties. In constructing the chart, any two of the five properties to be presented could be chosen as co-ordinates. Theoretically, therefore, there are ten different ways to plot the data. Some of these could be ruled out. For example, a t-s diagram would have no practical value since all constant pressure lines would converge toward a point at low temperatures. A t-v or t-h diagram would have little utility. In an h-p diagram, unless the pressure scales were made small, lines of constant t, constant v, and constant s would all be nearly parallel to constant h lines. This is because properties do not change rapidly with pressure. In p-v, p-t, and p-s plots, the same difficulty would arise. This leaves only h-s, h-v, and v-s as the remaining choices.

Enthalpy, being an important property, should appear as one of the co-ordinates. This eliminates the v-s diagram. Both an h-s plot and an h-v plot would be good schemes. The former is, however, considered more useful and convenient. It was decided to construct a large-scale enthalpy versus entropy chart with lines of constant pressure, constant temperature, and constant specific volume. (Enthaply scale: 1 cm = 2 Btu/lb; entropy scale: 1 cm = 0.002 Btu/lb/F.)

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[1] Advisory Engineer, Westinghouse Research Laboratories, Churchill Borough, Pittsburgh 35, Pa. Mem. ASME.

[2] Research Engineer, Westinghouse Research Laboratories, Churchill Borough, Pittsburgh 35, Pa.

[3] Only small portions of the chart are reproduced in this paper. The complete chart is available from Order Department, ASME, 29 West 39th Street, New York 18, N. Y., at $2.50 per copy.

[4] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Heat Transfer Division and presented at the Fall Meeting, Hartford, Conn., Sept. 23–25, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 57—F-10.

Constructing the Chart

Actual construction proceeded as follows:

1 Based on data in (1), which is considered to have the most reliable saturation data, the saturation line was drawn. Temperature, pressures, and specific volumes were identified along this line for later use.

2 Fourteen constant temperature lines, from 32 F up to the critical temperature of 705.4 F, were then constructed, based on the data in reference (1). Many of these lines are 100 F apart. Pressures were identified along these lines. Construction steps 1 and 2 are illustrated in Fig. 1.

3 To draw in the constant pressure lines, use was made of the relation that along an isentropic, $\int dh = \int v dp$. This is probably the most accurate way to construct the constant pressure lines, since v is a weak function of p. In the range of interest, except in the immediate vicinity of the critical point, the variation of v with p along any isentropic is rather modest.

The integration proceeded from the saturation pressure to 1000 psia, then from 1000 psia to 2000 psia, and so on up to 6000 psia. Values of v at constant entropy were obtained from (2). The trapezoidal rule of integration was found to be sufficiently accurate in every case. Integrations were carried out at entropy increments of 0.02 Btu/lb/F.

At temperatures lower than 680 F, the constant pressure lines so obtained are in excellent agreement with the pressures identified in step 2. Above 680 F, small discrepancies were noted. These were adjusted and smooth curves were drawn. In (1), the integration for enthalpy was carried out along lines of constant temperature. In the present work, the integration was carried out along lines of constant entropy. Construction step 3 is illustrated in Fig. 2.

4 To construct constant temperature lines in addition to those already drawn (see step 2), use was made of the specific heat data of Koch (9). Koch's data were also reported by Dorsey (5) and were converted into English units by Wellman (10, 11, 12).

Along lines of constant pressure, $\int dh = \int C_p dt$, where C_p = specific heat at constant pressure. Integrations were carried out in numerous steps, each step spanning only 2 F. The pressures at which the integrations were made were 1000, 2000, 3000, 4000, 5000, and 6000 psia. The integration limits were the constant temperature lines already drawn under step 2. The actual integration proceeded from both ends of a segment of a constant pressure line, the two ends usually being 100 F apart. At the middle of the segment, there was in some cases a small error of closure. On the average, this closing error in enthalpy amounted to 0.38 Btu/lb, which was adjusted by being apportioned evenly over the entire segment. This construction step is illustrated in Fig. 2.

At temperatures above 600 F, this procedure was not followed. Instead, an auxiliary t-s plot was made from the data in (1). Constant pressure lines were drawn in this auxiliary plot, which was then used as an interpolation device. At any given temperature, readings of p versus s were obtained from the auxiliary plot and transferred to the main chart. The auxiliary plot with much reduced scales is shown in Fig. 3.

Constant temperature lines were drawn at 2 F intervals from 32 F up to 650 F, and at 5 F intervals from 650 F up through the critical temperature.

5 To construct the constant specific volume lines, an auxiliary plot of v versus t with lines of constant p was made from the data of Smith and Keyes (5, 13). The p-v-t data of Smith and Keyes are considered very accurate and were used to develop other properties in (1.) At any given v, readings of p versus t were obtained from the auxiliary plot and transferred to the main chart. The auxiliary plot with much reduced scales is shown in Fig. 4. Constant specific volume lines were drawn at intervals of 0.0001 cu ft/lb except in the high temperature region, where the increment was enlarged to 0.0002 cu ft/lb and finally to 0.0005 cu ft/lb.

Using the Chart

Examples. These examples illustrate the use of the chart. The numerical figures used are arbitrary. They do not, as far as the authors know, pertain to any actual problem or situations.

A Heating at Constant Volume or at Constant Pressure. 25 Btu of heat is added to one pound of water initially at 430 F and 1500 psia. (*a*) What is the final pressure if the container is rigid? (*b*) What is the per cent change of volume if the pressure is kept constant?

The initial state can be read from Fig. 5: $p_1 = 1500$ psia, $t_1 = 430$ F, $v_1 = 0.018944$ cu ft/lb, $h_1 = 408.80$ Btu/lb, and the internal energy $u_1 = h_1 - (144/778.16) p_1 v_1 = 403.54$ Btu/lb.

(*a*) For a constant volume process $v_2 = v_1 = 0.018944$ cu ft/lb, $u_2 = u_1 + 25 = 428.54$ Btu/lb. The new state 2 is then determined by trial. With $v_2 = 0.018944$ cu ft/lb and by assuming a pressure p_2, the corresponding h_2 can be read from the chart and the value of u_2 computed. Make several trials until u_2 becomes equal to 428.54 Btu/lb. By such a process the new state is found to be: $p_2 = 5462$ psia, $t_2 = 462.71$ F, and $h_2 = 447.68$ Btu/lb (Fig. 5).

(*b*) For a constant pressure process $p_2 = p_1 = 1500$ psia, $h_2 = h_1 + 25 = 433.80$ Btu/lb. From Fig. 5 one now reads $t_2 = 452.77$ F, $v_2 = 0.019314$ cu ft/lb. The volume has therefore increased by 1.95 per cent. Notice that by adding the same amount of heat the temperature is about 10 F higher in the constant volume process.

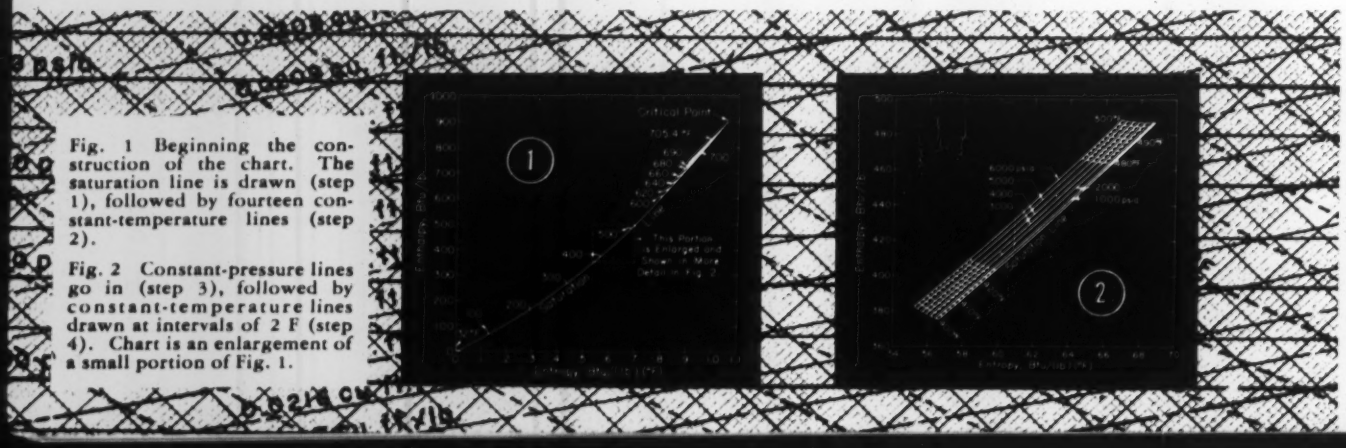

Fig. 1 Beginning the construction of the chart. The saturation line is drawn (step 1), followed by fourteen constant-temperature lines (step 2).

Fig. 2 Constant-pressure lines go in (step 3), followed by constant-temperature lines drawn at intervals of 2 F (step 4). Chart is an enlargement of a small portion of Fig. 1.

B Steady Flow With Heat Exchange. Water flowing in a horizontal, constant-area duct has a pressure of 3000 psia, a temperature of 380 F, and a velocity of 30 fps. The water is heated to a temperature of 550 F, while the pressure drops to 2750 psia. Find the heat added and the new flow velocity. (Note: Under these conditions, the total state and the static state are indistinguishable.)

From Fig. 6, one finds that for $p_1 = 3000$ psia and $t_1 = 380$ F, $h_1 = 357.35$ Btu/lb and $v_1 = 0.018091$ cu ft/lb. From Fig. 8, one finds that for $p_2 = 2750$ psia and $t_2 = 550$ F, $h_2 = 546.58$ Btu/lb and $v_2 = 0.021189$ cu ft/lb. Assuming no work is done by or upon the water stream, the heat added is $h_2 - h_1 = 546.58 - 357.35 = 189.23$ Btu/lb. The new velocity of flow is $30(0.021189/0.018091) = 35.14$ fps.

Had the change in specific volume been ignored, the velocity would have remained constant at 30 fps, resulting in an error of 14.6 per cent.

C Throttling (Constant Enthalpy Process). A water stream at 5000 psia and 470 F is throttled down to a pressure of 1000 psia. What is the new state?

The initial state is defined by $p_1 = 5000$ psia and $t_1 = 470$ F. One now reads from Fig. 9, $h_1 = 455.22$ Btu/lb. After throttling, the state is defined by $p_2 = 1000$ psia, $h_2 = h_1 = 455.22$ Btu/lb. One now reads from Fig. 9: $t_2 = 471.98$ F; $s_2 = 0.65300$ Btu/lb/F; and $v_2 = 0.019754$ cu ft/lb. Notice that here the Joule-Thomson coefficient is negative.

D Discharge Through an Ideal Nozzle (Isentropic Process). Water at a temperature of 640 F and a pressure of 5500 psia is discharged through an ideal nozzle to a pressure of 2000 psia. What is the final state? What is the discharge velocity? The approach velocity to the nozzle may be neglected.

From Fig. 7, the initial state is: $p_1 = 5500$ psia, $t_1 = 640$ F, $s_1 = 0.8323$ Btu/lb/F, $v_1 = 0.02311$ cu ft/lb, and $H_1 = h_1 = 654.90$ Btu/lb, where H denotes the total enthalpy and h denotes the static enthalpy. With no exchange of heat, work, or elevation, the total enthalpy remains constant. So $H_2 = H_1 = 654.90$ Btu/lb. $p_2 = 2000$ psia. The flow through an ideal nozzle is isentropic. So $s_2 = s_1 = 0.8323$ Btu/lb/F. Now again from Fig. 7 one reads: $h_2 = 639.44$ Btu/lb; $t_2 = 616.5$ F; and $v_2 = 0.02423$ cu ft/lb.

The discharge velocity is then $\sqrt{2gJ(H_2 - h_2)} = [(2)(32.174)(778.16)(654.90 - 639.44)]^{1/2} = 879.9$ fps. If the water in this problem had been considered incompressible, then the discharge velocity would have been $\sqrt{2gv_1(p_1 - p_2)(144)} = \sqrt{(2)(32.174)(0.02311)(5500 - 2000)(144)} = 865.7$ fps, which would have been in error by 14.2 fps.

E Water Pump. Saturated water at 100 psia is pumped to a pressure of 5500 psia. What is the pump work required and the final state of the water, (*a*) if the pump has an isentropic efficiency of 80 per cent? (*b*) if the pumping process is reversible and isothermal? Assume water enters and leaves the pump at the same elevation.

The initial state is obtained from Fig. 10: $p_1 = 100$ psia; $t_1 = 327.80$ F; $h_1 = 298.40$ Btu/lb; $s_1 = 0.47404$ Btu/lb/F; and $v_1 = 0.01774$ cu ft/lb.

(*a*) Following the isentropic from 100 psia to 5500 psia, one finds an enthalpy $h_2' = 315.98$ Btu/lb. The actual enthalpy h_2 is given by $(h_2' - h_1)/(h_2 - h_1) = 0.80$, from which one obtains $h_2 = 320.38$ Btu/lb. From Fig. 10, one then obtains $t_2 = 340.1$ F. By ignoring the difference between total enthalpy and static enthalpy, or by assuming equal water velocities entering and leaving the pump, the work required is $J(h_2 - h_1) = (778.16)(320.38 - 298.40) = 17{,}100$ ft lb/lb of water pumped. External heat transfer is assumed to be zero.

If the pumping process had been isentropic, that is, reversible and adiabatic, the work required would have been $(h_2' - h_1) = 315.98 - 298.40 = 17.58$ Btu/lb = 13,680 ft lb/lb of water pumped.

(*b*) For isothermal pumping $t_2 = t_1 = 327.8$ F, $p_2 = 5500$ psia. One then reads from Fig. 10, $h_2 = 307.88$ Btu/lb, $s_2 = 0.46386$ Btu/lb/F, and $v_2 = 0.017338$ cu ft/lb. The work required in this case is equal to the increase of enthalpy of the water minus the heat added to the water from external sources. For a reversible isothermal process, the heat added is equal to $t(s_2 - s_1)$. If the difference between total enthalpy and static enthalpy is ignored as before, the pump work required is $(h_2 - h_1) - t(s_2 - s_1) = (307.88 - 298.40) - (327.80 + 459.69)(0.46386 - 0.47404) = 17.50$ Btu/lb = 13,620 ft lb/lb of water pumped. The heat removed is 8.02 Btu/lb of water.

F Discharge of Water From a Pressure Vessel. A closed vessel contains water at 5000 psia and 580 F. The vessel is accidentally damaged and the enclosed water discharges to atmospheric pressure. Determine the state of the initial escaping fluid after it has gotten outside the vessel.

The system one has to deal with in this problem is sometimes called the open system. The initial fluid experiences a semi-flow process such that its enthalpy after escape is equal to its internal energy before escape. This example applies only to the initial element of fluid leaving the vessel. The details of discharging the entire vessel could be solved by means of a step-by-step calculation and making use of the chart.

From Fig. 8 one finds the initial state: $p_1 = 5000$ psia; $t_1 = 580$ F; $v_1 = 0.021364$ cu ft/lb; $h_1 = 580.25$ Btu/lb; hence, $u_1 = 580.25 - (144)(5000)(0.021364)/778.16 = 560.49$ Btu/lb. The final state is $h_2 = u_1 = 560.49$ Btu/lb, $p_2 = 14.696$ psia. Hence from (1) one finds the steam quality = 0.392, $v_2 = 10.52$ cu ft/lb, and $t_2 = 212$ F.

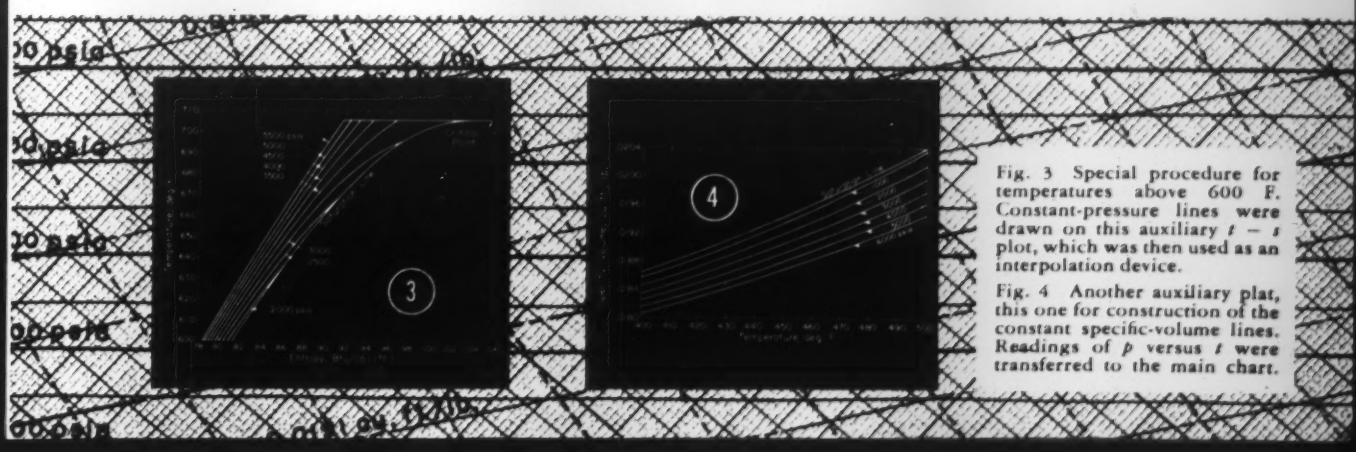

Fig. 3 Special procedure for temperatures above 600 F. Constant-pressure lines were drawn on this auxiliary $t - s$ plot, which was then used as an interpolation device.

Fig. 4 Another auxiliary plat, this one for construction of the constant specific-volume lines. Readings of p versus t were transferred to the main chart.

Acknowledgment

The work reported herein was conducted at Westinghouse Research Laboratories with partial financial support of Westinghouse Atomic Power Division.

Mr. A. T. Pieczynski, of Westinghouse Research Laboratories, assisted in the numerical computation.

Mr. H. G. Kozlowski, also of Westinghouse Research Laboratories, assisted in the drawing of the chart.

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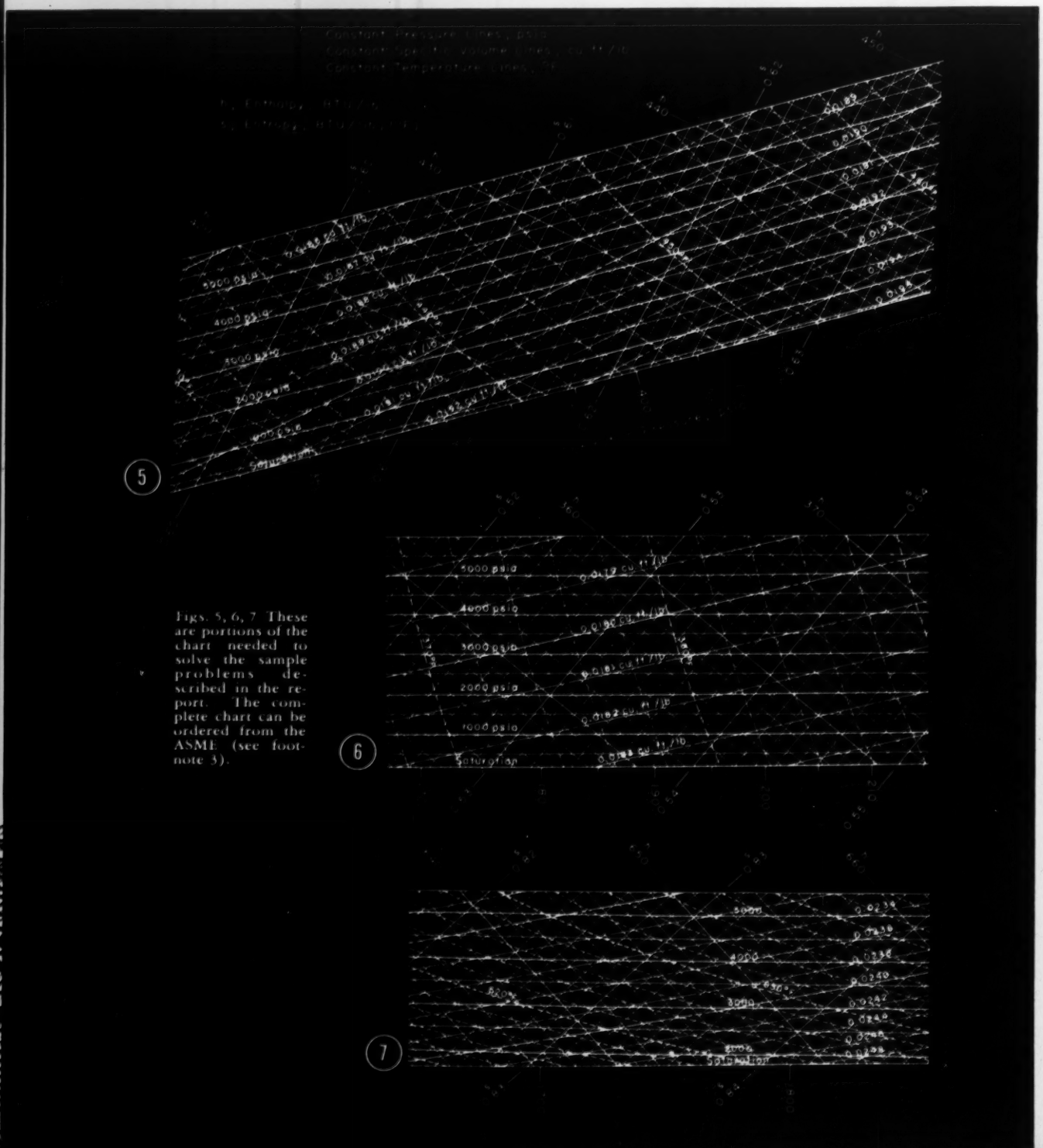

Figs. 5, 6, 7 These are portions of the chart needed to solve the sample problems described in the report. The complete chart can be ordered from the ASME (see footnote 3).

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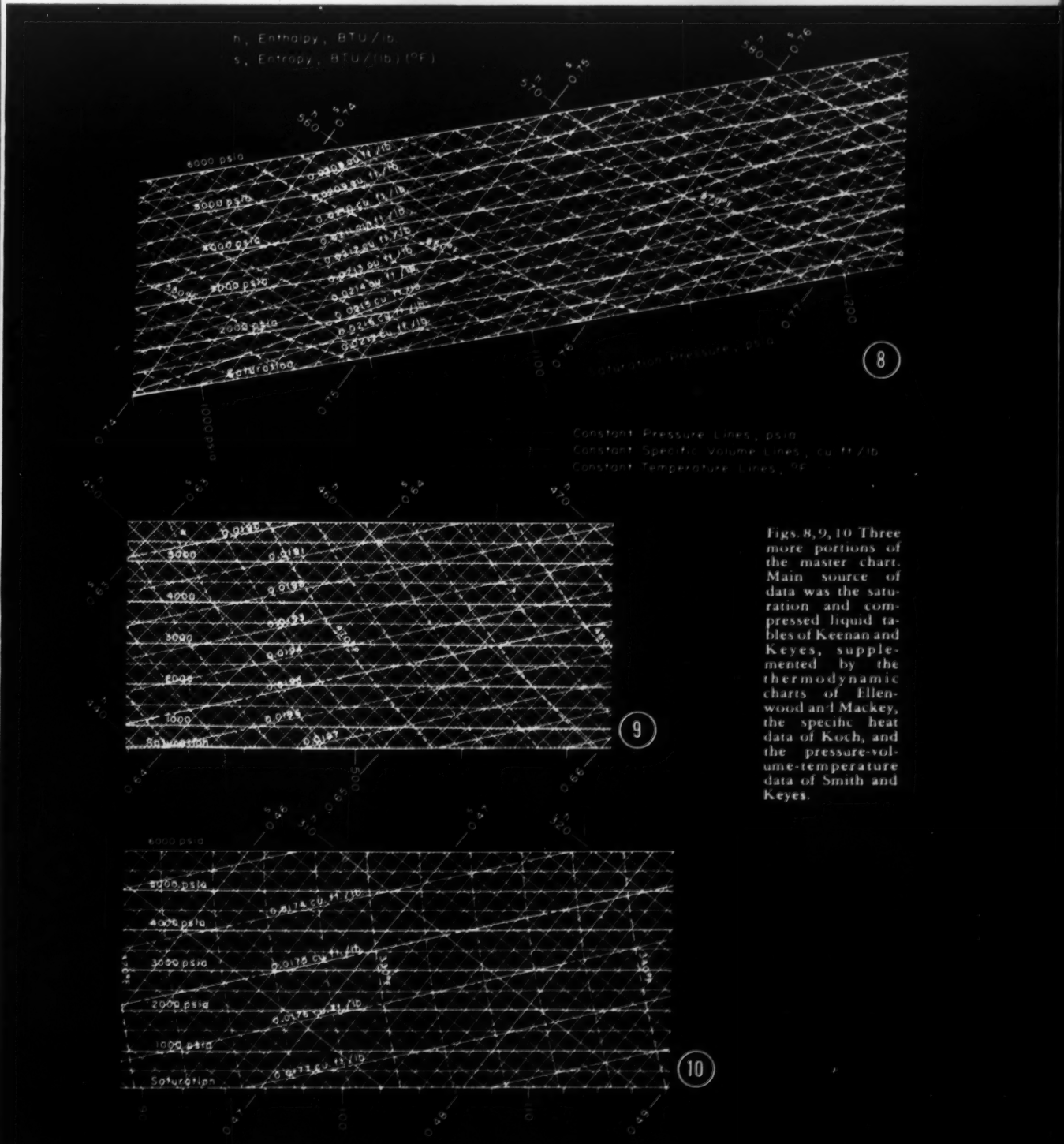
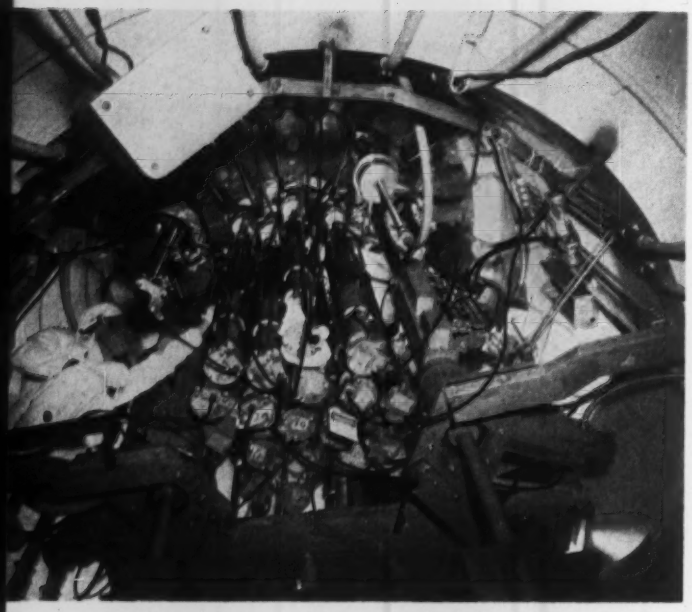


Figs. 8, 9, 10 Three more portions of the master chart. Main source of data was the saturation and compressed liquid tables of Keenan and Keyes, supplemented by the thermodynamic charts of Ellenwood and Mackey, the specific heat data of Koch, and the pressure-volume-temperature data of Smith and Keyes.

Briefing the Record

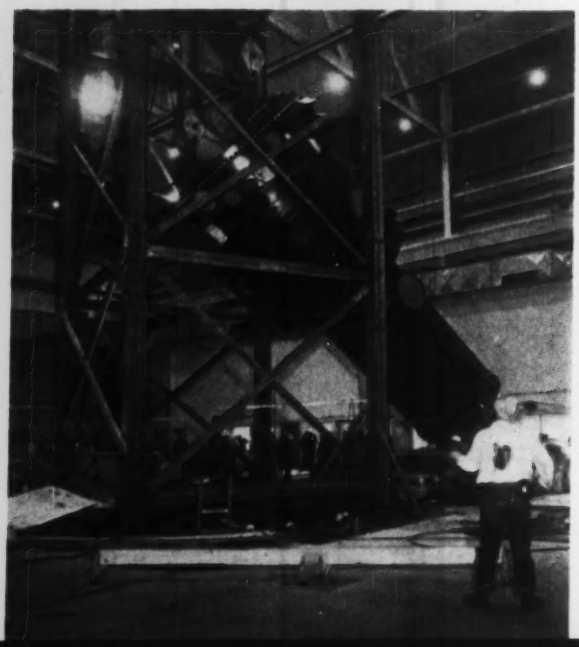
Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*



▲The control-rod drive mechanism is at the bottom of the ETR to facilitate access to the top of the reactor, and for greater safety

▼The 75-ton reactor vessel as it was raised to near-vertical position for lowering into the external thermoshield receptacle. The vessel is 35 ft high with a 12-ft upper diam and an 8-ft lower diam.



Engineering Test Reactor

THE 175,000-heat-kw pressurized-water-cooled fully enriched-uranium-fueled Engineering Test Reactor, largest of the material and component-testing-type reactors, was given an industrial preview on October 2 for members of Congress, representatives of the AEC and of the organizations responsible for the design, construction, and operation—Kaiser Engineers, Phillips Petroleum Company, and the General Electric Company. The ETR went critical last month, 23 months after the start of construction.

The $17.3-million reactor, newest member of the group of reactors at the vast National Reactor Testing Station, about 50 miles west of Idaho Falls, Ida., was an outgrowth of overwhelming demands on the neighboring 5-yr-old Materials Testing Reactor. Phillips Petroleum Company, operator of the MTR, will operate the ETR and was responsible in part for the conceptual design.

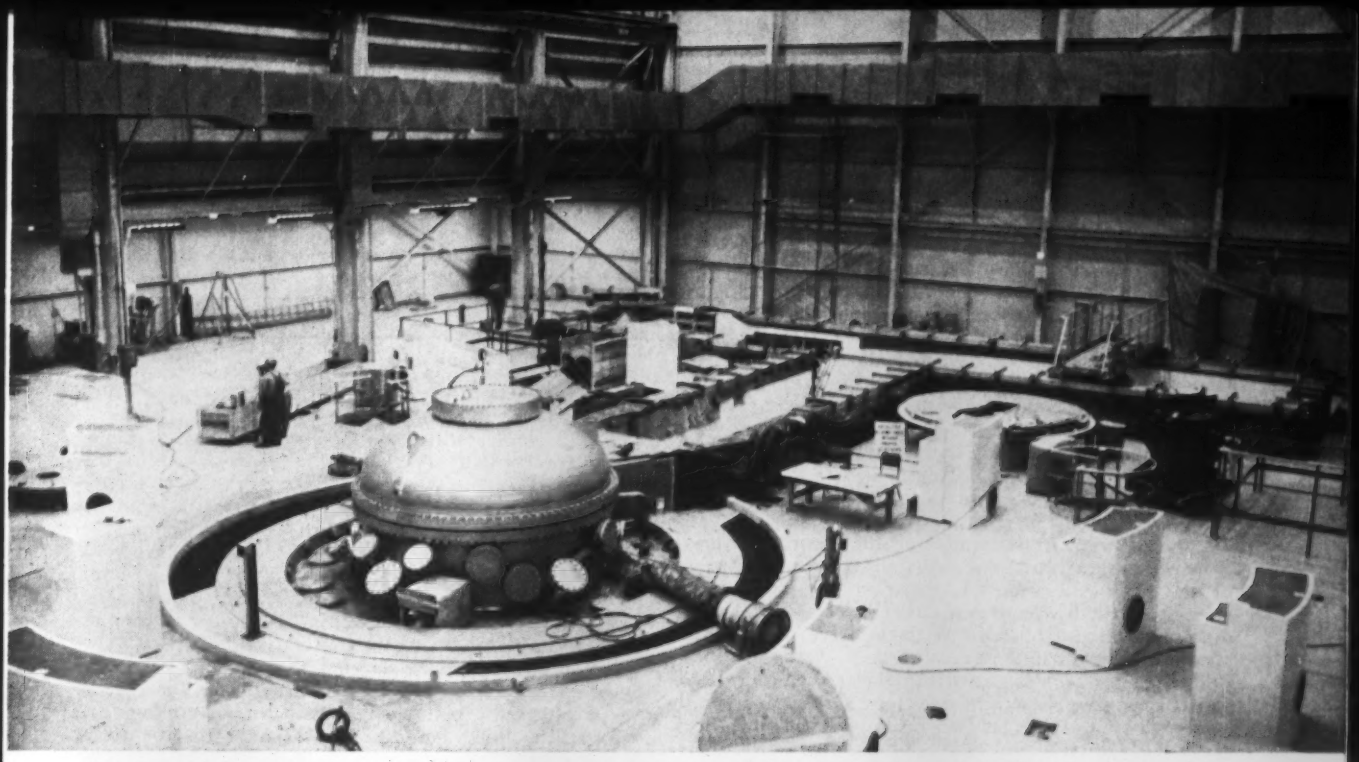
While the MTR is primarily for experiments which fall in the research classification, the ETR with the highest power rating and heat flux of any test reactor is able to irradiate much larger quantities of materials and is more suitable for experiments designed to provide engineering and performance data.

At the end of June, 30 high-temperature power-producing reactors were built, being built, or planned in the U. S. as full-scale civilian power reactors. W. Kenneth Davis, Mem. ASME, and director of reactor development for the AEC, predicts that more than 50 new test reactors will be necessary to support the installation of 2200 or more nuclear power plants through 1980.

The ETR has the highest average thermal flux, 40×10^{13} neutrons per sq cm sec, available for materials testing of any reactor in the world. It also provides the largest volume of experimental holes within the core—9 of them, ranging from 3 in. sq to 9 in. sq × 36 in. long—many times larger than any previously available. In addition, there are 131 experimental holes, 8 of which are 3 in. × 36 in. or larger, immediately adjacent to the core.

The most important applications will be test materials, fuel elements, components, and coolants, at extremely high thermal and fast fluxes; simulation of flux distributions for proposed reactors; and the performance of accelerated irradiation tests.

The reactor core occupies a matrix of 100 3 × 3-in. squares, and of these, the experimental facilities occupy 31 positions. Each of these facilities is surrounded by fuel, and all except two of the 3 × 3-in. facilities are through holes. Additional facilities in the slab beryllium reflector, and the region containing aluminum reflector pieces, include two 6 × 6 in. and six 3 × 3 in. through facilities, in the aluminum region, similar to those in the core.



Interior of the Engineering Test Reactor, looking down on the reactor floor. The top plug of the reactor is in place. The plate-type covers are over the experimental access holes. The white blocks standing around the reactor plug are removable concrete shielding which fits around the reactor during operation.

Thus it is possible to arrange experiments in the form of self-contained loops which pass completely through the reactor-core region, and which may contain such components as flowmeters, pumps, and heat exchangers, which are isolated from the reactor equipment and instrumentation.

An example is the liquid-fuel loop which contains its own circulating pumps, heat exchangers, and other units built into an integral in-pile unit. Heat is exchanged to a gaseous secondary coolant whose inlet and outlet lines enter the reactor through the access holes at the top of the pressure vessel.

High-pressure-water test systems, gas and liquid-metal-coolant systems, particularly of NaK, will all be incorporated into these loops. Studies of fuel-element performance at pressures up to 2500 psi and 700 F are contemplated.

Outside the core region, and surrounding it, is a slab beryllium reflector with additional experimental holes and a region containing removable aluminum reflector pieces, each of which contains a hole into which samples may be placed. In addition to these experimental areas there are through facilities which are similar to those in the core. Aluminum filler pieces occupy the remaining space.

The whole assembly of core and reflector areas is contained within the inner reactor tank. Cooling water is made to flow down through the core, beryllium, and aluminum reflector pieces, and back up through the internal thermal shields located between the reactor tank and the pressure vessel.

In order to reduce thermal stress, the pressure vessel is made considerably larger than the inner reactor tank. The space between is filled with thermal shields consisting of (*a*) four concentric cylinders of Type 304 stainless steel around the core; (*b*) the vessel wall; (*c*) an external steel-plated and lead-filled shield cooled by water in stainless-steel tubing.

The reactor vessel is constructed of carbon steel SA-212 firebox-quality, grade B, clad with Type 304-ELC stainless steel, and designed for cooling water at 250 psig and 200 F.

The control system relies upon 16 control rods and a regulating rod; 4 conventional, thermally "black," poison rods absorb essentially all of the thermal neutrons striking them, and are used only for scram shutdown; operational shim control of the reactor is accomplished through the use of the remaining 12 "gray" rods, whose absorption and scattering cross sections approximate closely those of a normal fuel rod. The major effect of their insertion is the removal of the source of fission neutrons without severely perturbing the neutron flux in the vicinity of the experimental facilities.

Biological shielding utilizes magnetite concrete $1^1/_2$ times as dense as conventional concrete to achieve a thinner shield. Experiments were necessary for the design development in the absence of adequate data on magnetite concrete.

Top head shielding consists of circular disks, or washers, and flat circular plates. This assembly rests on block segments arranged in a circle. The segments in turn rest on the solid-concrete shield.

The design of the ETR has been based upon carrying the core heat-transfer rate to the maximum safe limit, in order to obtain the highest possible neutron flux. The coolant system is of the double-loop type. There are four banks of three heat exchangers each, in parallel, in the primary system, each bank being stacked in a vertical plane.

The secondary loop rejects the heat to the atmosphere through a cooling tower. Water purity of $^1/_2$ ppm is maintained in the primary system whose pressure is 200

psia at the inlet of the reactor vessel and 150 psia at the outlet. Inlet temperature is held at 110 F by controlling the flow of secondary water through the heat exchangers. Total flow through the reactor is 44,000 gpm, giving an outlet temperature of 138 F.

Pressurizing of the primary coolant system is accomplished by continuously pumping 300 gpm of water into this system and withdrawing water at the required rate to balance and control the pressure.

Gas formation in the core must be prevented so the heat-transfer coefficient will not be reduced. The degassing system is combined with the pressurizing system, and water passing out through the back-pressure valve is sprayed into a degassing tank through a bank of spray nozzles.

Control-rod drives were placed below the core to simplify access to the reactor from the top, and also as a safety measure. In disconnecting the control-rod drive from the rod, each time the top of the reactor was opened or the head was removed, there would be danger of start-up of the fission reaction through accidental withdrawal of the control rods. With the drive disconnected, scram shutdown would be precluded.

The reactor building structure above grade level was constructed of a structural-steel frame, insulated metal-sandwich-type siding, and an insulated-metal roof deck with built-up roofing. To provide for gas tightness, the metal roof decking was installed upside down, thereby providing a flat surface approximately 2 in. wide that received a 3-in-wide pressure-sensitive lead tape. This tape was applied to all roof joints and on the metal siding joints except where welding was used. When smoke-bomb and Freon tests indicated leakage, sealing strips were added on the inside edge of the roof and siding joints.

Further details of the ETR are contained in "Engineering and Construction of the Engineering Test Reactor," by P. D. Bush and others. Part I was presented at the 1957 Nuclear Congress as Paper No. 57—NESC-106, and a digest appeared in the May, 1957, issue of MECHANICAL ENGINEERING, p. 476; Part II was presented as ASME Paper No. 57—SA-31 (see August, p. 769). A digest of "The Design and Testing of Containment Provisions for the Engineering Test Reactor," by P. D. Bush, J. Finke, R. W. Zeiser, E. A. Dukleth, J. P. Ernst, and A. T. Chute, ASME Paper No. 57—SA-23, appears in the Technical Digest section of this issue.

Nuclear Briefs

▶Boiling Reactor Facility

ARGONNE NATIONAL LABORATORY has awarded a contract to United Engineers and Constructors, Inc., of Philadelphia, Pa., for the detailed design, in co-operation with Argonne engineers and scientists, of a boiling reactor facility to cost about $\$8^1/_2$ million and to be erected at the Laboratory's Idaho Division site.

Purpose of the plant to be known as ARBOR—Argonne Boiling Reactor—will be the investigation of full-scale boiling-water power-reactor systems operating at pressures up to 2000 psi and developing 200,000 kw of heat under varying conditions. ARBOR will have approximately ten times the power of the Experimental Boiling Water Reactor already operating at the Lemont, Ill., laboratory site at a pressure of only 600 psig.

▶Gas-Cooled Reactor for Ships

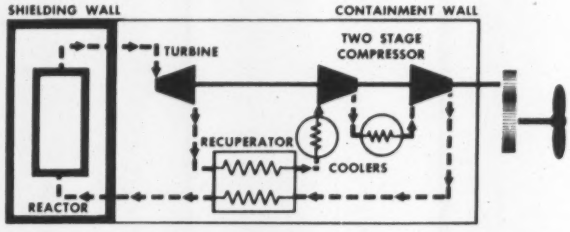
The Atomic Energy Commission and the Maritime Administration have asked industry for proposals to develop a nuclear power plant, suitable for propelling merchant ships, consisting of a gas-cooled reactor coupled with a closed-cycle gas turbine.

The gas-cooled reactor's principle of operation is based on the use of an inert gas under pressure for direct transfer of energy from a reactor to a turbine. No heat exchanger and secondary loop are involved, as in the pressurized-water reactor and other contemporary designs.

This action is a continuation of a joint long-range program aimed at the development of advanced reactor systems for commercially competitive propulsive power for ships in the U. S. Merchant Marine. As part of this development program, studies of the feasibility of nuclear propulsion of gas-cooled, closed-cycle systems have been completed by the General Motors Corporation; Ford Instrument Company, a Division of Sperry Rand Corp.; and General Atomic, a Division of General Dynamics Corporation.

A contractor will be selected to carry out necessary development work to arrive at a firm design for a land-based prototype plant. A balanced research and development effort, building on existing reactor technology, should make possible the construction of such a prototype plant within 5 to 7 years from award of the initial development contract.

Work is now progressing on development and construction of the first nuclear-powered merchant ship, announced by the President on October 15, 1956. The Babcock and Wilcox Company is carrying forward work under a $9,872,000 contract to supply major components of the pressurized-water nuclear-propulsion plant for this ship. A preliminary design of the vessel itself has been completed and it is anticipated that a contract for its construction will be awarded in the next few months. The ship is scheduled for operation in 1960.



▲Basic components of the closed-cycle gas-cooled reactor systems proposed by Ford Instrument Company

▼Cutaway model of gas-cooled nuclear reactor installed in the hull of a merchant ship

The first commercial Cockroft-Walton Accelerator produced in the U. S. Tubular corona rings prevent breakdown of the high voltage existing between ground and the higher voltage shell which contains the accelerator's ion source. Inside the corona rings are the ten decks comprising the voltage multiplier power supply. The accelerating tube and target cabinet are at the upper left.

▶ First Commercial Accelerator

The first commercial Cockroft-Walton Accelerator produced in the United States is enroute to the University of Arkansas from its manufacturer, Applied Radiation Corporation, Walnut Creek, Calif.

The 350,000-ev machine will accelerate a 400-mu amp beam of positive ions to generate neutrons of various energies for research in nuclear chemistry and physics.

Applied Radiation Corporation was formed less than four years ago by physicists and engineers from California and Stanford Universities and is affiliated with the Archer-Daniels-Midland Company. The company specializes in the development and manufacture of high-power-electron and positive-ion accelerators for research and for commercial processing. Several very-high-energy linear electron accelerators are under construction for high-energy physics research, and a 2 to 10-mev rental linear electron accelerator is maintained by the company.

▶ BB's Used for Shielding

A hot cell at the Westinghouse Materials Engineering Department's radiation and nucleonics laboratory uses 35 tons of bb-shot between $^1/_2$-in-thick steel walls spaced 15 in. apart as shielding. They are the equivalent of 10 in. of solid steel in the ability to contain atomic radiation and make the hot cell portable, since the shot can be drained through special openings near the base of the walls.

▶ Nuclear-Powered Missiles

The use of nuclear power to propel missiles of the future is being seriously investigated by Lockheed Missile Systems Division.

The nuclear propulsion studies will be further advanced with a new atom smasher at the Lockheed nuclear laboratory, one of the facilities of the Missile Division's research and development center located in Stanford University's industrial park at Palo Alto, Calif.

The 3-million-volt Van de Graaff positive-ion accelerator is the largest such device in use within the aircraft industry, and the first of its type on the West coast.

▶ Fission Products Not Waste

Isotopes can be produced in several ways. The action of fission itself produces radioactive atoms in major quantities, there being about 150 different fission products of various characteristics. Isotopes can be obtained by chemical separation from the atomic ashes of power and production reactors. There is a need, according to AEC Commissioner Willard F. Libby, speaking at the dedication of the Nuclear Division Plant of The Beryllium Corporation, Hazleton, Pa., to emphasize this fact clearly because misconception of the value of these materials exists. The task of dealing with their disposal in the sea and even in interplanetary space is frequently put as a major one for the atomic development.

Dr. Libby stated, "I believe this is unlikely to be the situation, and that the value of the fission products as isotopes will be such that, except for the most dilute and intransigent solutions, valuable use will be made of them. They should not be called waste. This is a misnomer."

Regarding the current uses of isotopes, he stated that a comparatively new use is to facilitate oil-well simulation. This use for radioactive tracers already represents a large potential source of profit to the oil industry, as indicated by the reported savings of $180 million per yr in terms of getting more oil out of the same piece of ground, and doing it more cheaply, and it seems likely that this will come to amount to more than $1 billion annual savings shortly.

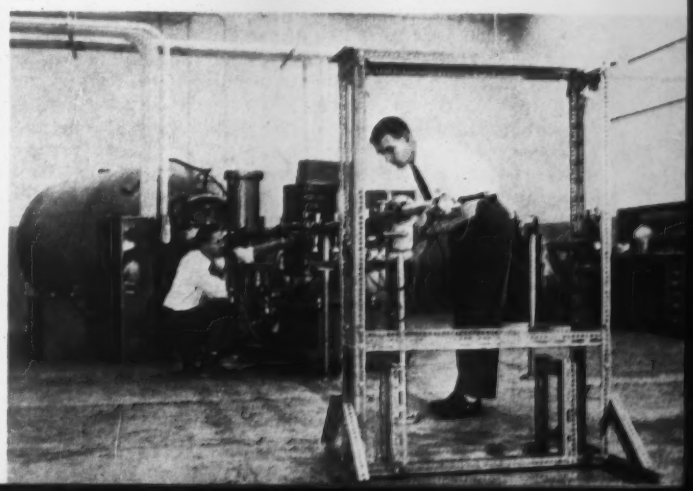
Atomic Energy Report

DURING the first 6 months of 1957, advances were made in all major programs, according to the twenty-second semi-annual report of the Atomic Energy Commission.

Peaceful Uses

The Experimental Boiling Water Reactor was dedicated by the Commission on February 9, at Lemont, Ill.

Adjusting Van de Graaff positive-ion accelerator for experiments leading to the use of nuclear power for missile propulsion at the Lockheed nuclear laboratory



A second pilot plant reactor, the Sodium Reactor Experiment, achieved criticality in April and began experimental operation at Santa Susana, Calif.

The Army Package Power Reactor achieved criticality and later began producing electricity at Fort Belvoir, Va.

Other experimental reactors, including the Organic-Moderated Reactor Experiment and the Homogeneous Reactor Experiment No 2, are expected to achieve criticality during the next 6 months.

The full-scale 60,000-plus kw Pressurized Water Reactor at Shippingport, Pa., was scheduled to go into operation this year.

A contract was signed for design and construction of a reactor power plant for the first nuclear-powered merchant ship.

Industrial participation increased both under the Commission's Power Demonstration Reactor Program and in independent plans for construction of reactors.

Two formal proposals were received from private industry to build central station power reactors—one in Florida, one in the Midwest—in response to a third invitation issued in January.

In other developments under the demonstration program, a contract was signed with the Power Reactor Development Company for a 100,000-kw reactor in Michigan and for development work on a new type of reactor proposed for construction in Alaska.

Full-scale construction got under way this spring on the Commonwealth Edison Company's 180,000-kw power plant near Joliet, Ill., and on the Consolidated Edison Company's 275,000-kw combined nuclear and conventional plant at Indian Point, N. Y. The 5000-kw reactor plant of the General Electric Company and Pacific Gas and Electric Company at Pleasanton, Calif., was completed, and was scheduled to begin operation soon. These three reactors are being financed exclusively from private sources.

Three additional industrial groups announced independent plans to build four full-scale atomic power plants: one in California, two in the Ohio River Valley, and one at an undetermined site. This brings to ten the number of power reactors which private organizations are building or have announced plans to build.

During this reporting period, 11 nuclear reactors built in the United States achieved criticality for the first time. In addition to the Sodium Reactor Experiment and the Army Package Power Reactor, 6 of the remaining 9 reactors were for research and training purposes.

In the same 6-month period construction was begun, major components were ordered, or construction permits were issued, for a total of 22 reactors in the United States. The 22 included one AEC power-reactor experiment, 11 military power reactors, 2 research reactors, 2 testing reactors, and 6 critical experiments. Licenses were issued for export of 7 research reactors.

The largest expansion took place in the category of new reactors planned. Intent to build 35 reactors in the United States, of which 7 would be exported, was announced. Of the total, 24 would be research and training reactors (6 for export), 2 would be testing reactors, and 3 critical experiments. Six of the 35 reactors were announced as full-scale civilian power reactors (1 for export); 4 were announced by industry as independent projects.

Radioisotope users in the United States increased from slightly over 3600 to 4109, a rise of about 12 per cent.

Rates of uranium production both in the United States, and in other areas of the free world continued to mount, and reached a point where the United States has a 10-yr uranium supply in sight, sufficient for the military and civil power-development programs projected for that period and for international commitments. In the United States alone, the annual rate of production was expected to approximate 14,000 tons of uranium oxide by the end of 1958, with some 22 mills processing more than 18,000 tons of ore daily.

Military Development

The Commission continued production of a variety of nuclear weapons, including weapons for defense, in accordance with Presidential directive.

Expansion of research and development, and production facilities proceeded according to schedule.

Weapons tests were conducted at the Nevada Test Site, the first on May 28, in accordance with the Commission policy of periodically using this site for experiments or tests involving relatively low yield nuclear detonations.

The *USS Nautilus* was refueled after the first nuclear-powered submarine cruised more than 62,000 miles, some 36,000 while fully submerged.

The land-based prototype of the *USS Seawolf's* reactor was shut down. The *Seawolf* ran her sea trials and a Naval board recommended that this submarine, powered with a sodium-cooled reactor, be accepted for restricted service, but that the reactor ultimately be replaced with a Nautilus-type power plant.

The *Skate*, first of a new class of five nuclear submarines planned by the Navy, was launched at Groton, Conn., on May 16.

Design and development work continued on other naval reactors, including a power plant for a cruiser and one for a destroyer.

A contract was let for design and construction of a gas-cooled power-plant reactor for the Army.

Construction of test and service facilities began for the aircraft reactor program.

The AEC continued studies relating to the application of nuclear power to rocket and ramjet engines.

Research

In the reactor field, in addition to those experiments near completion and reported earlier, development work went forward on a number of reactors, including the fast breeder reactors, and molten plutonium, and other liquid-metal-fueled reactors.

The AEC carried forward its program to improve reactor safety with two reactor experiments at the National Reactor Testing Station in Idaho, and a third in California.

Development work continued on new types of fuel elements, including plutonium-alloy elements, and some containing 20 per cent of U-235—the top enrichment generally permitted for shipment to other countries under agreements for co-operation.

The AEC authorized a program to advance design and use of "electronic brains" in atomic research.

Biomedical, biophysical, and biochemical studies were made of the effects of radiation on living systems, the treatment of these effects, and protection against them.

Three additional projects were undertaken in the

study of the effect of radiostrontium in fall-out material from nuclear weapons tests.

The Commission took part in presentations made before the Joint Committee on Atomic Energy in extensive hearings during May and June on fall-out from weapons tests and presented, as requested, facts and analysis concerning the effects of fall-out with particular reference to the continuance of weapons tests.

Universal Transfer Device

A UNIQUE universal transfer device called the Planobot, and made by the Planet Corporation of Lansing, Mich., can simulate just about everything a man's arm, wrist, and hand can do.

The idea for the Planobot was conceived when a large automobile corporation's engineers asked Planet to solve a hazardous problem that was undesirable for manual performance. The operation involved the handling of hot castings from a die-casting machine through a water-quenching, and from there into a press die for trimming. To further complicate the problem, the machine had to be converted easily to new cycles to meet production changes and modifications.

The result of three years of development, the Planobot is hydraulically operated and controlled by an electronic sequencing unit. Its movements can be determined either manually by an operator or predetermined by a set-up on a plug-board arrangement in the master control panel.

There are five basic motions. The grasping device on the horizontal arm opens and closes, and rotates 360 deg. The arm will extend or retract, raise or lower, and rotate 270 deg in a horizontal plane. In all, it is capable of performing a total of 25 individual movements during any one cycle or sequence, and adjustments can be made in a matter of minutes to set the Planobot for an entirely different cycle of operation.

All movements are powered hydraulically, either by cylinder or hydraulic motor and gear trains from a common hydraulic pump in conjunction with an accumulator. Hydraulic flow for each movement is controlled by direct-acting double-solenoid directional valves in conjunction with speed-control valves. The main turret rotater has a double-valving system for accelerating and decelerating.

Each movement is connected mechanically to a multi-turn or linear potentiometer. Amount of any movement can then be represented or measured by amount of resistance. After initiation of a movement, that movement will continue until its resistance matches a preset resistance in a plug-board arrangement of the master control panel. When a match or dead band is made, the movement stops. Sequencing movements are accomplished by means of a variable-time-stepping switch.

The master control panel contains four rows of jack sockets of 30 sockets each. Each row represents a movement; that is, main swing, tilt, retract, or similar motions. In addition, there are two rows of potentiometers; one row of 10 colored black, and one row of 12 colored red, which are used as reference or preset resistances to control the degree of any movement.

A typical cycle setup would be as follows: The stepping switch is set to zero. If the first movement in the cycle is main swing, then a jack matching the color code of the first preset potentiometer is inserted in hole number 1 of the swing-movement jack-socket row. The amount of swing is then controlled by the setting of the preset potentiometer. If the next movement is arm extend, a jack matching the color code of preset potentiometer number 2 is inserted in hole number 2 of the arm-extend jack-socket row. This setup may be continued until the total of 25 individual movements are predetermined.

The Planobot, a universal transfer unit, simulates practically every motion of a man's arm, wrist, and hand for handling hot castings and similar materials. It is capable of performing a total of 25 individual movements during any one cycle.

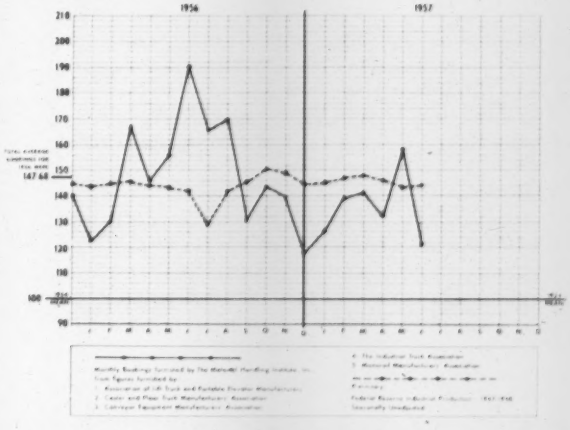
Material Handling Equipment

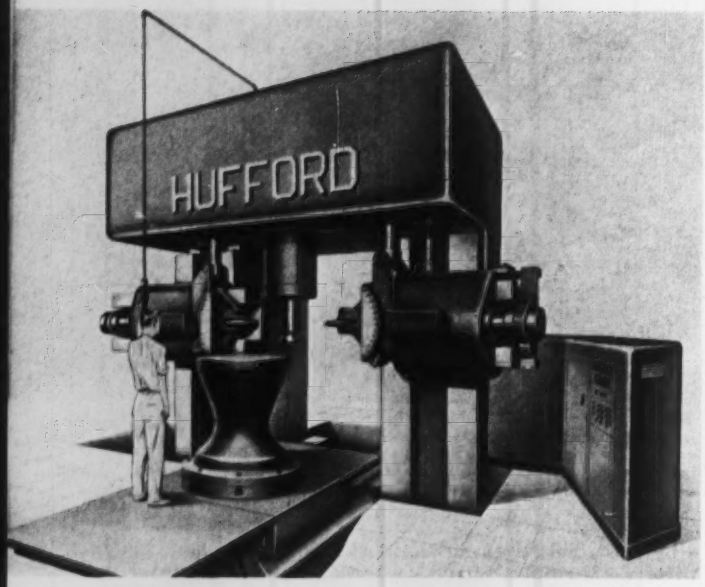
DESPITE a 23.1-per cent slide-off for June, in dollar volume of orders received by material-handling-equipment manufacturers, the Material Handling Institute, Inc., reports a constantly increasing climb in orders received for the first 6 months of 1957, as compared with the steady decline during the last half of 1956.

Using 1954 orders received as a statistical base of 100, the recently compiled June bookings are translated as 121.57. The average dollar volume of monthly orders received through June is 136.43.

The Institute's bookings index also shows that the dollar volume of 1957 business for the first 6 months represents 46.19 per cent of the total business received last year, and 68.21 per cent of the bookings received in 1954, the statistical base year.

Monthly bookings index reported by the Material Handling Institute, Inc.





The features of a vertical spinning lathe and a process for forging wall thickness of sheet parts are combined in a new concept in machine design called a spin-forge

Spin-Forge

COMBINING the features of a vertical spinning lathe with a process for forging the wall thickness of sheet parts is a new concept in machine design. The machine, known as the Hufford Spin-Forge developed by The Hufford Corporation, formerly Hufford Machine Works, Inc., El Segundo, Calif., enables forming of parabolic, hemispherical, conical, hour-glass, and other shapes from a single piece. In addition, it provides facilities for forging the metal, varying the wall thickness starting from a full inch, and reducing this to as little as a few thousandths.

Force used for spinning and forging is applied by two opposed rollers, hydraulically actuated. The rollers feed vertically down the form longitudinally into die contours, and, being mounted on angular-tilting heads, can follow all contours maintaining a right-angle contact with the work surface. Travel of the rollers in all directions is tracer controlled, following templates automatically. Each roller works independently of the other in any of its several motions.

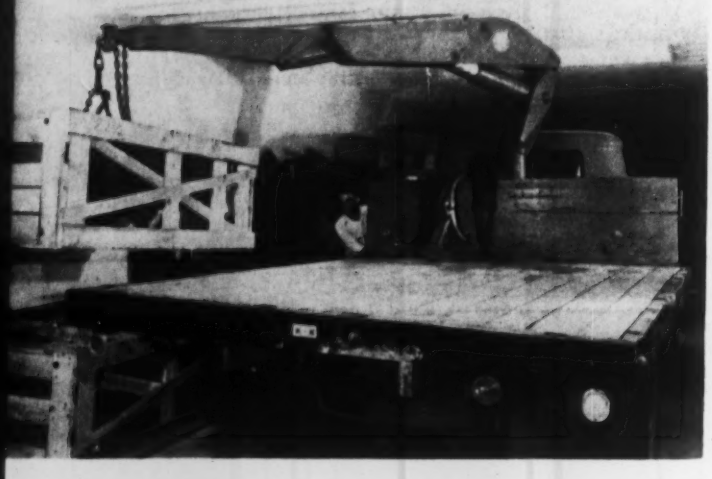
The die, contoured to the shape of the finished part, is mounted on a rotating table having spindle speeds up to 400 rpm. The entire table and spindle are carried on a slide which can be moved outwardly from the forming position. This simplifies loading and removal of parts without overhead barriers, and reduces over-all height requirements of the massive structure.

Power for the spindle drive is furnished by a 200-hp motor. A 225,000-lb forming force is supplied to each roll by hydraulic cylinders operating at 3000 psi. Feed rate is 60 in. per min.

The system includes a closed TV circuit with 2 Hallamore cameras and screens for close-up vision from a remote location, providing operator safety in case of part failure. Other circuits provide for programming the forming operations for automatic duplication of parts.

Two basic machine types are indicated by present requirements. The original machine, to be installed in the Marquardt Aircraft Plant at Ogden, Utah, will handle a 60-in-wide by 60-in-long part. The machine is designed to work Type 321 stainless steel of 1-in. thickness, reducing this to $^1/_2$ in. in a single pass. Multiple passes can be programmed when greater reduction is necessary. Other plans indicate need for increased size capacity to 120 by 120 in. This machine will handle the forming of thin-walled parts for uniform wall thickness such as tank ends, missile noses, aircraft fuselage components, and similar applications. Other models may be developed for other industries.

This one-man-operated fully hydraulic truck crane requires only 15 in. of space between the cab and truck bed, and has a range of lifting capacities from 2500 to 6000 lb



One-Man Hydraulic Crane

A FULLY HYDRAULIC, one-man-operated truck crane is being distributed by Stanco Manufacturers and Sales, Inc., of Los Angeles, Calif. Manufactured originally in Sweden, and known as the Hiab 170, this new truck crane requires only 15 in. of space between the cab and truck bed, leaving the entire truck bed open for load. The Hiab 170 offers a range of lifting capacities from 6000 lb on the shortened boom of 5 ft, to 2500 lb on the full boom of 13 ft. The boom length is easily adjustable through hydraulic control. The crane will lift up to 20 ft above ground level at a maximum speed of 20 ips. Control is from either side of the truck cab. Crane action is positive and accurate, and swings in a 360-deg arc. When not in use, the Hiab 170 folds snugly behind the cab in the 15-in. space alloted to it. Hydraulic outriggers to handle heavy loads are standard equipment.

With complete parts and service available throughout the United States, the Hiab 170 has proved ideal for handling air-conditioning equipment, plumbing and heating equipment, sheet-metal assemblies, refrigeration equipment, roofing supplies, and the loading and unloading of crates and boxes containing any materials.

Biggest Boltmaker

THE largest automatic cold-forging machine ever built —a $500,000 giant Boltmaker—is turning out $1^1/_4$-in-diam hexagon-head cap screws at the rate of 40 a min at The Cleveland Cap Screw Company in Cleveland, Ohio.

This marks the first time that it has been possible to produce cold steel forgings larger than $^3/_4$-in-diam by automatic methods.

The big Boltmaker—five years in the making—was designed primarily to make large-diameter cap screws and industrial fasteners. The machine continuously produces hexagon-head cap screws, hexagon and square-head bolts, and high-strength structural bolts in sizes from $^7/_8$ in. up to and including $1^1/_4$ in. diam and up to 10 in. long.

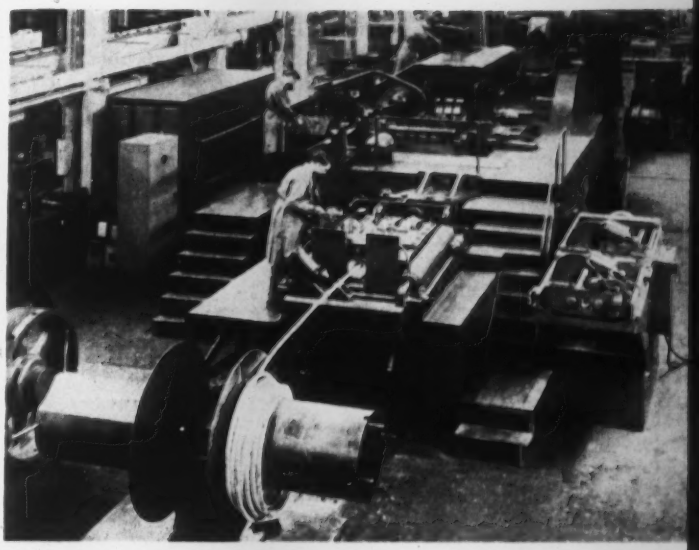
The greatest contribution of the giant Boltmaker may be its as-yet untried ability to produce odd-shaped components far larger than any turned out before by automatic cold-forging; such special components as pinion drive shafts, pump shafts, transmission shafts, insulator pins, big rivets, coupling bolts, ball-joint suspension parts, and various gear blanks.

The machine takes wire or rods larger than the nominal diameter of the finished fastener, and by a series of operations reduces this wire or rod to a pitch diameter ready for rolling. The machine then will automatically head, point, and roll-thread the fastener.

The new Boltmaker has variable-speed electronic controls, the first such machine to be so equipped. These permit operation at any speed from 4 rpm up to 40 rpm, with precise speed control which is particularly important when running large special upsets.

The first Boltmaker, a $^3/_8$-in. machine built by National Machinery Company in 1935 is still in use at Cleveland Cap Screw Company. Since the first one was made, larger and larger sizes have been built, up to the $^3/_4$-in. size. Thus the basic design has been well established.

Nevertheless, many new problems had to be solved. Suppliers' facilities were strained in making the big heavy-duty castings for the base of the machine. Heat-treating the thick-sectioned crank-shaft and other parts created other problems.



World's largest automatic cold-forging machine is this $1^1/_4$-in. Boltmaker which makes possible the automatic production of cold steel forgings larger than $^3/_4$ in. in diam. The giant machine turns out steel hexagon-head cap screws $1^1/_4$ in. in diam and up to 10 in. long at the rate of 40 per min.

Screw Parts Washer

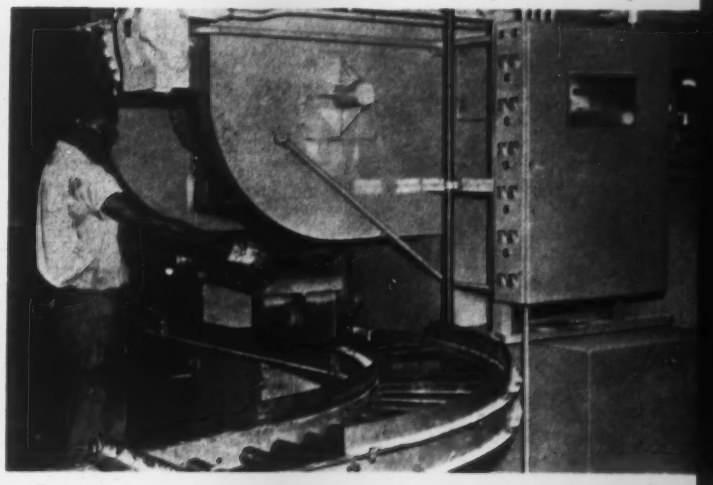
AUTOMATIC washing, rinsing, and drying of screw parts coated with quenching oil, and simultaneous cleaning of the tote pans containing the screws are accomplished by a new type washing machine designated the Roto-Jet. The washer is designed and built by Industrial Systems Company, Matawan, N. J., for the Parker-Kalon Division of General American Transportation Corporation, manufacturers of self-tapping screws.

The Roto-Jet washer features a number of specially designed drum fixtures, constructed so that the tote pan containing the screws to be cleaned is clamped to the bottom of each fixture by a semiautomatic locking device. As each loaded fixture enters the washer it is slowly rotated as it passes through the washing, rinsing, and drying cycles. When heavier work items are processed, the drum fixture is gently rocked, instead of rotated, to prevent nicking of parts. Chemicals may be added to the rinse to provide the work with a rust inhibitor. The fixture with the tote pan containing the parts returns to the operator clean and dry.

The advantage of the washer is that batches of screw parts of different sizes can be consecutively fed into the machine without becoming mixed as they are processed, a procedure that could not be accomplished by previous cleaning methods. In addition, the problem of cleaning the tote pans for holding the clean processed screws has been accomplished.

Model RJ-WRD heats by steam, is operated by one man, and processes a tote pan of parts every minute at normal operating speed. The machine is readily adaptable for efficiently cleaning stampings, small castings, machine, and electrical parts.

The Roto-Jet washer automatically washes, rinses, and dries screw parts coated with quenching oil, and simultaneously cleans the tote pans containing the screws



Plating-Machine Design

NORMALLY, product design starts on the drawing board. To improve automation in the mechanical end of the plating field, the plating-equipment division of Wagner Brothers, Inc., Detroit, Mich., combined the drawing-board technique with a 12-ton 31-ft production-floor laboratory or operating mock-up. The combination makes possible 65 per cent reduction in the delivery time for automated, custom-ordered plating equipment, and subsequent fabrication on a semimass-production basis, with lower costs for installation and operation. To date, some 15 innovations have been made in equipment-component design.

The aluminum lofts which adopt some of the principles of lofting used by the aircraft industry include every modular structural and mechanical advancement made by the company thus far, scaled to an accuracy of 0.003 in.

Engineers pick off the lofts any plating-machine-element features desired for a custom-ordered machine and combine them quickly into a master-working blueprint for manufacturing. In place of the 1300 man-hours of design engineering formerly required to build a typical 120-ft plating machine, roughly 350 to 400 engineering man-hours complete the job.

A 45-ft fixture enables two men to tack and final-weld precut steel structural members for the base and uprights of a typical plating machine in 50 to 60 per cent less time than formerly required. All steel members are precut to standard dimensions direct from the mill.

Mechanical "splicing" joins the various modular sections enabling plating machines to be built completely on the production floor, tested, and shipped with a minimum of dismantling. Machines can be sectionalized in any convenient length for shipping purposes merely by removing a few bolts, and reassembled ready for dry cycling in a few hours.

The package gear-driven elevator mechanism complete with housing permits either transfer (lift) or horizontal-index motion by the elevators at any point in the span of the machine, rather than at the locations governed by tank-transfer operation in most conventional machines. Together with increased lifting capacity this permits reduction in number of elevators necessary by as much as 80 per cent. A complete elevator assembly can be mounted or replaced in about 45 min by semiskilled labor.

A "feather-drop" hydraulic control unit on the hydromotor which powers the elevators completely eliminates the jerky starts and jarring stops usually associated with plating-machine-elevator motion. The new unit controls acceleration, and deceleration of the elevator's vertical movement permitting extremely "soft" contact between work carriers and cathode rails.

A special compensating assembly makes possible the spacing or work racks within multiple-station tanks at intervals which give maximum operating efficiency without impact, allows individual variation in the thickness of plating, permits the use of a higher current density without burning corners of work, and can also result in a shorter over-all machine length.

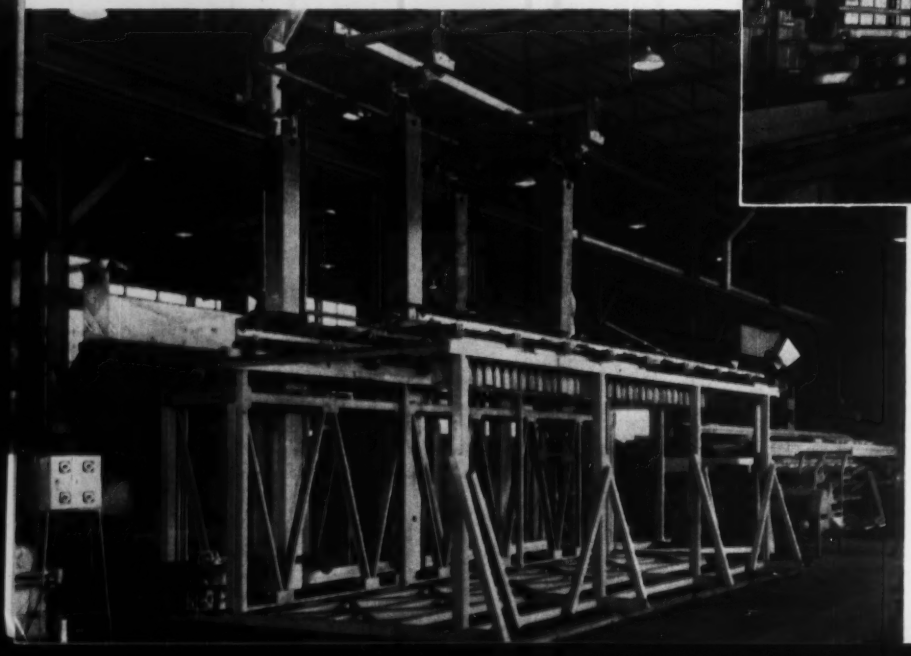
Horizontal-carriage-travel power is supplied by a special hydraulic rotary actuator. This unit achieves simple harmonic motion, and extreme smoothness in acceleration and deceleration. Motors of this type operate at 45,000 to 60,000 in-lb of torque, at 450 psi.

Doubly Oriented Magnetic Sheet

"FOUR-SQUARE" silicon iron, a new kind of sheet material designed to increase the efficiency of transformers, motors, and generators, has been developed at the General Electric Research Laboratory.

Doubly oriented magnetic sheet has been a research goal for more than 20 years, ever since metallurgists learned how to make singly-oriented sheet materials that can be easily magnetized in two directions. "Orientation" in silicon iron is achieved by aligning the individual crystalline grains in the finished sheet material. The doubly-oriented four-square effect is produced by a different kind of alignment, technically referred to as "cube texture," which gives excellent magnetic properties, not only back and forth along the sheet, but also back and forth across the sheet.

▲ Some of the new features of automatic plating machines. Newly designed friction-type clamps are at the immediate right. Workers are adjusting the rotary actuator which provides "feather" control in movements of the elevator.



◀ Basic engineering and production information for plating-machine building, is provided by this operating mockup. Unit here is lifting four 300-lb weights in a fatigue test.

Rigid control of the internal structure of the metal during all steps of processing, from the original casting through successive heat-treating and rolling-mill operations, is the secret. The basic raw material is a form of silicon iron similar in composition and cost to the typical kinds of "soft" magnetic sheet used in modern transformers and motors.

The iron core in a transformer serves as a conductor of magnetic lines of force, guiding them from the primary winding coil to the secondary winding coil. With 60-cycle a-c current, the direction of magnetization changes 120 times every sec. The core's resistance to these changes causes a loss of energy—and reduced efficiency through the generation of heat—and also causes actual mechanical vibrations in the core which result in annoying "transformer noise."

Theoretical metallurgists work side by side with processing experts in the development of "four-square" silicon iron. Proper timing of processing steps is essential for the carefully controlled properties of four-square iron.

By appropriately lining up two-directionally oriented sheet in a transformer, generator, or motor, most—but not all—of the magnetic flux could be carried in these "easy" directions. This discovery has had a significant impact on the technology and economics of electrical apparatus. The currently used product has reduced transformer-core losses to 1/10 of the original unalloyed iron, and 1/5 of those of the original silicon-iron alloy. Four-square sheet promises even further improvements in efficiency.

Jet Air Freighter

AMERICA's first jet-age commercial air freighter, a 16,200-hp propjet Lockheed Hercules, has been offered to airlines.

The air freighter will be the first commercial plane ever produced at Lockheed's Marietta, Ga., factory. The initial airplane can be in service in early 1960.

Designed from the beginning as a true air freighter, the turbine-powered Hercules is the first U. S. commercial plane using "straight-in," truck and dock-level loading. It is readily adaptable to the high-speed, mechanized-cargo-handling system foreseen in the near future.

The Lockheed Hercules merchant ship of the air will be a more powerful version of the C-130 military cargo carrier. The 4-bladed props and more powerful turbines will lift 22 tons from virtually any airport, and carry cargo at 350 mph.

The Hercules is capable of lifting more than 22 tons for a nonstop distance of 1750 statute miles, with normal fuel reserve. Payloads of more than 16 tons can be carried more than 3000 statute miles nonstop, with normal fuel reserves.

Normal cruising speed of the Hercules will be in the 350-mph range at altitudes to 30,000 ft.

The air freighter has been designated as Lockheed's production model 282A and is actually a civilian version of the recently announced C-130 "B" model military transport. The first civilian Hercules will have considerably greater range, and heavier payload capabilities than currently operating C-130A's. It is a high performer off high-altitude airports. It can also utilize back-country unpaved airstrips and can operate effectively virtually anywhere on the globe.

Big, low-pressure tandem tires and reversible-pitch propellers make it as maneuverable as a truck. The plane is easily backed into position under its own power, and can be turned in its tracks by means of a steerable dual nose wheel.

Four Allison (General Motors) 501-D22 turbine engines, rated at 4050 equivalent shaft horsepower each, will be the power plants. The advanced engines give an increase of 300 eshp per engine over the C-130A, or a gain in power of 1200 eshp per plane. The freighter will use 13½-ft, 4-bladed propellers instead of the 15-ft, 3-bladed propellers on the C-130A. Fuel tanks will carry 6900 U. S. gallons—1900 more gallons than the C-130A.

The strictly utilitarian Hercules models have been in Air Force operational service since December, 1956. They have already performed such spectacular feats as crossing the American continent at low level on only two of their four engines, taking off and landing in 800-ft distances, and airlifting such heavy equipment items as a 5000-gal jet-fuel tank truck.

The heavy-haul craft has a cargo floor only 41 in. off the ground. An integral tail-loading ramp is 9½ ft long by 10 ft wide. This ramp can be lowered to the ground for drive-on cargo or used in the level position. The aft opening in the Hercules is 10 ft wide by 9 ft high. A large forward cargo door, 6 ft 7 in. wide by 6 ft high, makes possible off-and-on loading of the Hercules simultaneously.

The high-wing airfreighter is designed for fast turnaround at freight terminals. "Single-point" refueling of the plane can be accomplished while cargo is being worked.

Automatic Zone Refining

AN AUTOMATIC refining device which will reduce electrically active impurities in silicon to less than one part in one billion has been developed at Bell Telephone Laboratories. It utilizes the floating-zone refining technique in which a molten zone is swept through the silicon, carrying impurities with it. The method can also be used to purify germanium, molybdenum, tungsten, and many other materials.

The new level of purity made possible by this device may lead to the manufacture of improved transistors, diodes, and other semiconductor devices. It also will assist in completing an evaluation of the intrinsic properties of silicon, and permit a better understanding of conduction properties in high-resistivity semiconductors.

Zone refining, also developed at Bell Laboratories, utilizes the fact that most impurities are more soluble in molten than solid material. Thus a molten zone swept along a rod of silicon will accumulate impurities from the silicon. The technique is being successfully applied to refining a growing number of materials: metallic, inorganic, and organic.

No satisfactory solid-crucible material has been found for containing silicon during the refining process. Fused silica, frequently used in zone refining, is attacked by molten silicon. For example, contact with commercial fused silica for 1 hr introduces about 1 to 3 parts per billion of electrically active impurities to molten silicon at 1450 C. The floating-zone process, however, requires no crucible and so is free from such contamination. The molten zone, supported only by surface tension, is passed along a vertical silicon rod held rigidly at both ends. Refining is performed in a controlled atmosphere by surrounding the rod with a water-cooled gas-tight envelope. Inductive heating produces the molten zone, and motion of either the heating coil or the rod sweeps the zone along. This process is repeated, with the molten zone always traversing the rod in the same direction, until the desired purity is obtained.

The new automatic apparatus developed at Bell Laboratories consists of a 10-kw, 4-megacycle generator, mechanical means for moving the rod up and down while it is rotating inside a gas-tight silica enclosure, and switching means for automatically recycling the mechanism.

Initially, because of its high resistivity, the end of the silicon rod must be heated to about 800 C by conduction from a molybdenum chuck which is heated by the radio-frequency generator. Power is thereafter absorbed by

Two-Stage Free-Piston Engine

A NEW free-piston engine, with two stages of compression of the scavenging air, has been announced by the Baldwin-Lima-Hamilton Corporation, of Philadelphia, Pa. The Hamilton Division reports that the new FP-165 has been "fully designed," and only production engineering is required to ready it for manufacture.

The advanced feature of the FP-165 appears in its bounce cylinder. As in all free-piston engines, the diesel piston and the larger air piston are a single assembly, driven one way by combustion in the diesel cylinder, and bounced back by air pressure in the bounce cylinder. (Shaft output is that of a gas turbine, the exhaust of the diesel cylinder being fed to the turbine.) Previous engines have utilized only the return stroke of the air piston to pump air for scavenging. The BLH FP-165 takes pressure from the outward side as well. Thus both strokes of the compressor piston build pressure for the scavenging air space.

The new engine is so designed that the bounce energy on the pistons is proportional to the output gas pressure, and requires no further control.

The operation is such that the compressor discharge valves are subjected only to the first-stage pressure and temperature. This allows a rise in delivery pressure and power without excessive stress and temperature on the valves. An extension of this advantage is that gasifier intake pressure can be raised to 1.5 times atmospheric pressure by a turbocharger without the need for intercooling. This outside supercharging results in a 60 per cent boost in power output.

A single FP-165 is reported to produce 125 shp (turbine) without turbocharging. Analyses show that it combines the excellent power-to-weight ratio and torque characteristics of the open-cycle gas turbine, with the economy and efficiency of the diesel. It far surpasses the diesel in torque and power-to-weight.

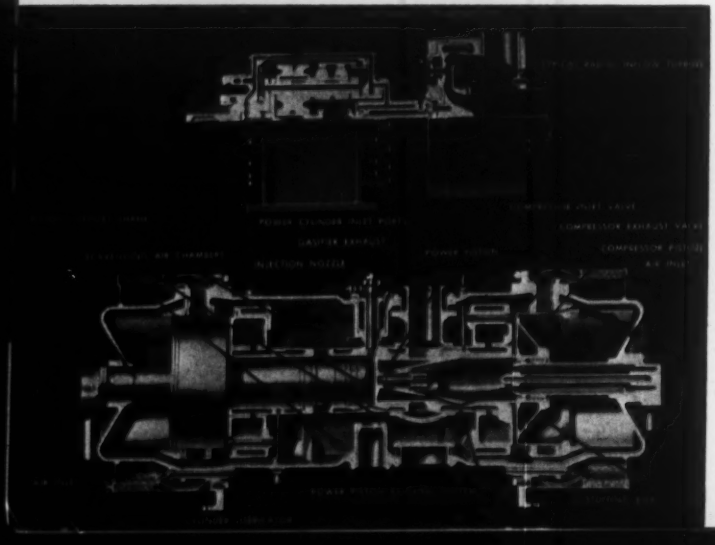
It is claimed that the engine may be the most efficient user of fuel ever developed. It is adaptable to burning a wide range of fuels, and could replace other internal-combustion engines in many areas.

The most promising immediate uses are for stationary and mobile power plants, railroad locomotives, marine power plants, farm equipment, large tractor-trailer power plants, construction equipment, and other off-the-highway power-driven vehicles.

As with previous free-piston engines, units can be stacked, so that several gasifiers feed one large turbine. Thus total power can be the total output of all the gasifiers—or as many as are intended to be "on the line" at once, allowing for standbys. This arrangement permits great flexibility and reliability. A gasifier can be overhauled while the engine is running.

Because of their small size and weight, FP-165 units can be handled without the use of heavy cranes and other bulky tools.

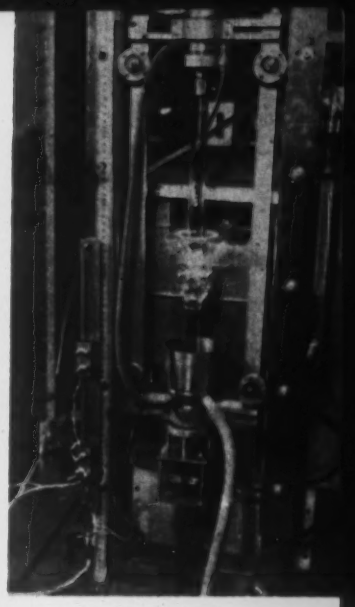
The FP-165 two-stage free-piston engine. Part of the air pressure generated in the outer "bounce" chamber is used to augment the scavenging air pressure. In previous free-piston engines, scavenging pressure was provided only on the inward stroke of the pistons. It is also reported that the new configuration permits the increase of intake pressure by outside turbocharging without intercooling. A single FP-165, not turbocharged, can deliver 125 shp.



the rod itself, and all subsequent operations are automatic. The power is increased to a preset value, sufficient to produce the desired molten zone at a preset location, and the motor drives for the mechanism are started. These drives rotate the rod and move it downward, so that the molten zone traverses the rotating rod from bottom to top. When the zone reaches the top of the rod, a limit switch stops the rotation, and decreases the power to a preset value sufficient to keep the heated but now solidified zone at about 1200 C. This heated zone is then returned to its previous position near the bottom of the rod as the rod is raised by the drive mechanism. There, a limit switch raises the power to the preset value for melting, starts the rod rotating, and reverses its direction of travel. The automatic recycling continues thereafter as long as required.

Constant length and freedom from mechanical oscillation of the molten zone have been achieved by employing low heating current at a relatively high frequency, and by properly proportioning the load and generator impedances. Low currents minimize electro-magnetic levitation forces, the high frequency increases power-transfer efficiency, and a ratio of load-to-generator impedance less than unity stabilizes zone length. The load impedance decreases as the rod melts, so that as the zone tends to lengthen, less power is put into the load, and the temperature drops, thus tending to decrease zone length. Crystals of uniform diameter are secured by control of the ratio of zone length to rod diameter, so that the upward transport of material by the molten zone is balanced by the oppositely directed gravitational force.

By use of this equipment with a moist hydrogen atmosphere to remove boron, a single crystal of P-type silicon with a resistivity of 16,000 ohm-cm and minority carrier lifetime of 1200 microseconds has been obtained after 67 passes. This corresponds to an impurity content of less than 1 part per billion, thought to be the purest silicon ever produced in quantity.



A crystal of silicon being refined by the automatic floating - zone - refining equipment

Metallurgical Briefs

▶Aluminum-Forging Techniques

To cut cost and save weight on Boeing Aircraft Company's B-52, new forging techniques are used in producing main-landing-gear bulkheads—the weight supporting structure at each juncture of fuselage and landing gear.

The aluminum-forging techniques perfected by the Aluminum Company of America reduce machining man-hours by 62 per cent, save thousands of dollars in machine tool costs for each set of bulkheads, and the amount of aluminum originally used for 1 set now produces 8.

Using the Air Force's 50,000-ton press the forging leaves the giant press at such close tolerances that it weighs just 289 lb—67 per cent less than with blocker-type die forgings which in turn represented a saving over hand-forging method. Very little machining is required to arrive at the 230-lb finished-product weight resulting in lower manufacturing and shipping costs.

▶Titanium Stretch Forming

Startling savings in tools, man-hours, and expensive titanium, are the result of a new method of preparing its edges, developed by the Los Angeles, Calif., Division of North American Aviation, Inc.

By overcoming the metal's tendency to crack in stretch-forming wherever there are rough edges or shear fractures, the new method has reduced the mortality rate on stretch-forming operations from as high as 75 per cent to only 1 per cent, with increased quality.

Strips of titanium are mechanically pulled through a series of graduated cutting tools radiused to give the metal a smooth, rounded edge.

It would take eight men and 48 files to do the work that can now be done by one man and one machine at a cost of 50 cents per day for cutters, where six expensive vixen files per man per day were required to turn out 32 acceptable parts.

▶Aluminum-Powder-Metallurgy Products

Commercially available aluminum-powder-metallurgy products, first of their kind to be manufactured in this country, mark a major break through the thermal barrier making the use of aluminum in numerous high-temperature applications more advantageous than titanium or steel, and more easily fabricated than titanium.

The aluminum-powder-metallurgy products created by subjecting the powdered metal to heat and pressure, are available from the Aluminum Company of America, Pittsburgh, Pa., in the form of extruded shapes, forgings, sheet, foil, drawn and extruded tube, impact extrusions, fasteners, and wire.

Certain of the products can withstand temperatures up to 900 F—an advance of 300 to 400 deg.

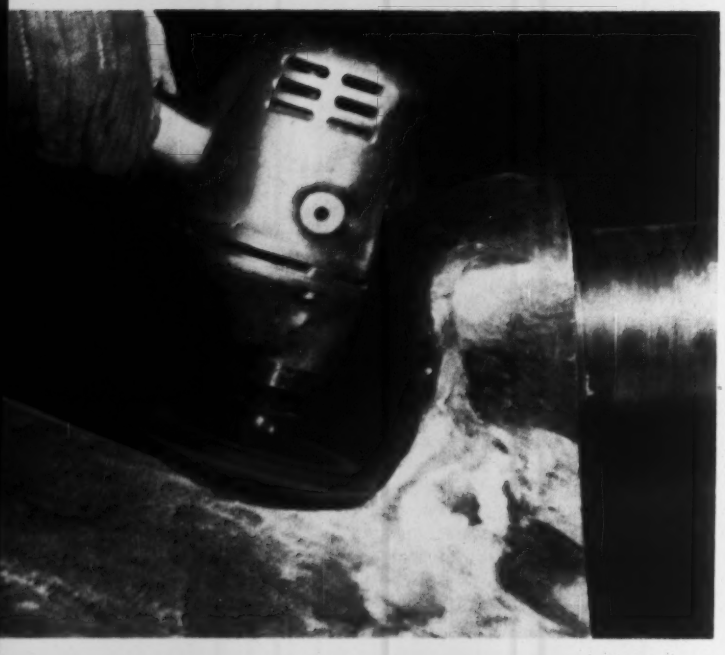
Where friction is encountered in certain engine components, anodizing can be used to insure a hard oxide coating, and to prevent moving parts from sticking. Aluminum-powder-metallurgy products can also be electroplated by regular methods. In addition, they have high resistance to recrystallization and to overheating.

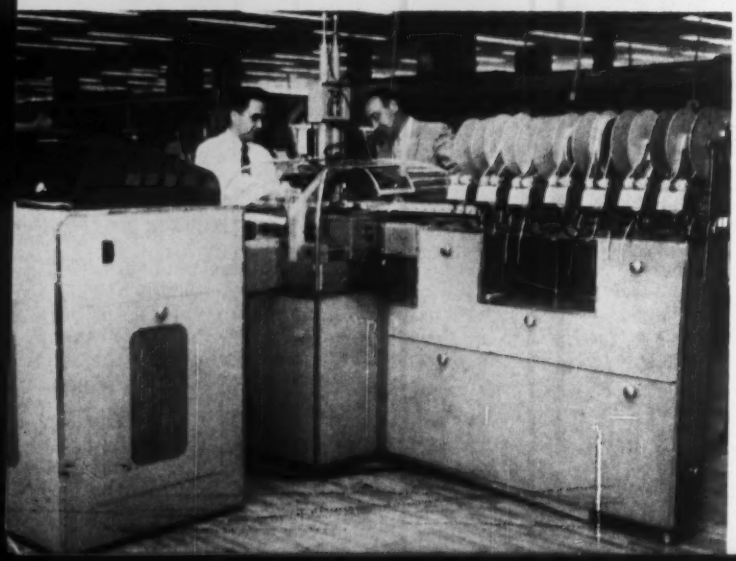
▶Gold-Coated Engine Shrouds

Gold-coated engine shrouds may help cool future aircraft according to patent applications recently filed by North American Aviation, Inc.

The reflectant noble metal coatings, serve to protect the metal shroud that surrounds the engines on advanced jet aircraft from heat and corrosion on the inside. At the same time, an exterior coating reduces the amount of heat radiated outside onto the components and structure of the aircraft. For these purposes, gold is far superior to silver, which may be used in the same way.

North American's new process enables the user to apply the gold-coating materials by brush, spray, or dip methods onto the metal shroud, or a high-temperature ceramic coating over the shroud, prior to heat-treatment, in thicknesses from 25/1,000,000 to 1/100,000 in.





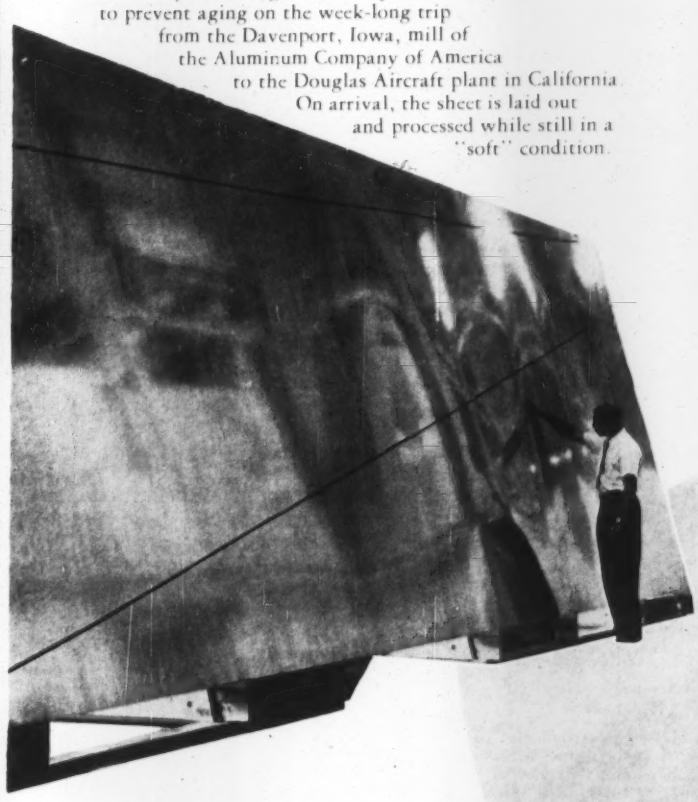
Aluminum Test Head. *Top*, North American Aviation impact tests helmets by swinging a 12½-lb weight in measured arcs, and striking with a velocity of 17 fps. Pickups in the head measure the force of the impact for comparison with simultaneous measurements inside the impacter.

Molded-Rubber Abrasive Disk. *Center*, contours difficult to reach with conventional pads are easily ground or polished with Resinall Metalite cloth abrasive 5 and 8-in.-diam polishing and stock-removal disks. The aluminum oxide abrasive with an all-resin bond is used on 120-X, 80-X, and 50-X grit disks without center nut, for use in any portable pneumatic or electric grinder, and made by Behr-Manning Company, Troy, N. Y.

Programmed Component Assembly System. *Bottom*, resistors, capacitors, diodes, and other components are automatically fastened onto printed-circuit panels by this IBM system. Operating from instructions on IBM cards, the system is automatically reset for new assignments. A proposed market version will accommodate any size panel up to 10 in. sq, operates to accuracies of better than 0.002 in., and locates the panel to receive a component at any intersect of a 0.050-in. grid at the rate of 1 per min. Several thousand components can be stored on a reel. Selection racks hold 20 reels.

Photo Briefs

Refrigerated Aluminum. An age-hardening alloy, specified for aluminum aircraft wing skin, can be machined and fabricated while soft but strengthens itself at room temperature without heat-treatment or tempering. The 10-ft-wide by 46-ft-long sheets are packed in dry ice to prevent aging on the week-long trip from the Davenport, Iowa, mill of the Aluminum Company of America to the Douglas Aircraft plant in California. On arrival, the sheet is laid out and processed while still in a "soft" condition.



Altitude Tests. Instruments and components for inertial navigators developed by the Autonetics Division of North American Aviation, Inc., were carried to near-90,000-ft altitudes —about 17 miles— in a metal-framed gondola. In four test ascensions from General Mills' flight center at New Brighton, Minn., they were safely parachuted back to earth after the gondola was released from the 128-ft-diam helium-filled balloon.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Copying Lathes as Transfer Machines

In the past three years there have been considerable advances in machine-tool control and operation. An interesting development is the linking together of successive copying lathes by transfer mechanisms. George Fischer Ltd., of Schaffhausen, Switzerland, has a range of nine hydraulically operated automatic copying lathes, but those which are of particular interest in this connection are the KDM-11, fitted with an automatic loader, and two of the KDM-7/50 type with automatic loaders, coupled together as a fully automatic transfer group. The KDM-11 is the larger machine of the two types and will swing up to $12^{3}/_{8}$ in. in diam and turn up to $8^{7}/_{8}$ in., with a maximum length of work of 28 in. or 40 in. according to the model in use. It is driven by a 20-hp motor and has 12 spindle speeds, from 140 to 1800 rpm, a range of feeds from 0.0035 to 0.028 in. per revolution, and a rapid traverse in either direction of 100 in. per min.

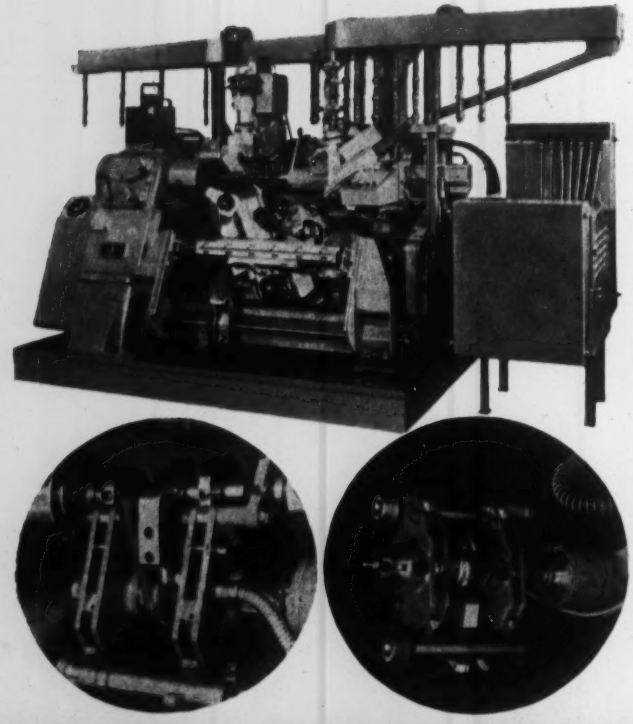
The automatic loader consists of a magazine, a loading and unloading gripper attachment, a conveyer, and a gaging and stop device. The blanks are stored in the magazine and fed by a swing mechanism to the loader, which brings a new piece into position between the centers as soon as the unloader has removed the previously finished piece. The finished work is gaged (on one diam) automatically. If the prescribed tolerance is exceeded, the cutting tool is automatically reset; or, if the departure from size is more than the automatic tool adjustment can cover, the machine stops. The finished work is deposited in another magazine.

Some B.S.A. Tools

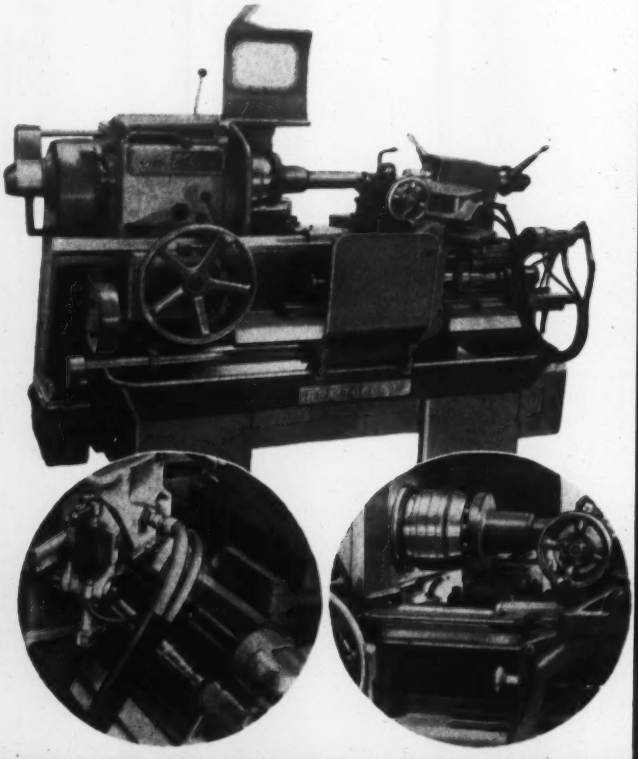
The Birmingham Small Arms Company, Ltd., of Birmingham, England, included a 6-in. hydraulic copy-turning lathe in their display at the fifth European Machine Tool Exhibition at Hanover. Not entirely a new machine, it has a maximum swing over the bed of 8 in. and over the tool slides of 6 in., and will take work 28 in. long between the centers. The stroke

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Copying lathe, KDM-11, equipped with automatic loading and unloading attachment. Loader consists of a magazine, a loading and unloading gripper attachment, a conveyer, and a gaging stop device. Circular insets: *left*, loading device; *right*, gripper for loading.



Copy-turning lathe, B.S.A. No. 6, extensively redesigned, accommodates a master pattern up to $5^{1}/_{4}$ in. in diam, and will take work 28 in. long between the centers. Circular inset: *left*, close-up of copying attachment and front saddle; *right*, close-up of controls.



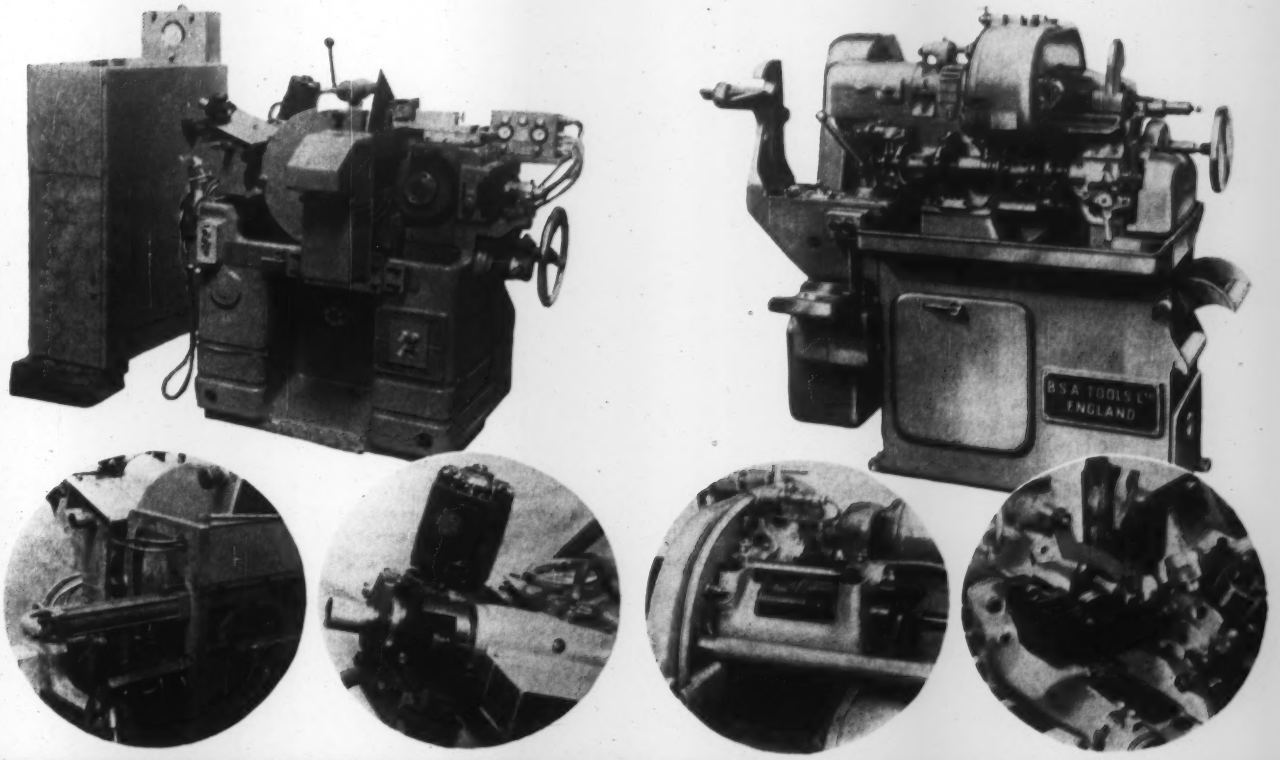
of the saddle is 29 in., the forward maximum stroke of the hydraulic slice is $2^{7}/_{8}$ in., and the maximum stroke of the rear slide is 3 in. The machine will accommodate a master pattern up to $5^{1}/_{4}$ in. diam. The hole through the spindle is $1^{5}/_{16}$ in. diam, and the range of spindle is from 217 to 1810 rpm. The front saddle has an automatic longitudinal feed taken from a constantly rotating shaft. The feed range is from 0.003 in. to 0.30 in. There is a hydraulically operated saddle return and slide-relieving unit which automatically relieves the tool slide from the cut just before disengagement of the saddle traverse and returns it to the starting point.

Also on the B.S.A. stand at Hanover were an automatic centerless grinding machine with a production rate of 450 operations per hour, and a single-spindle automatic screw machine fitted with a number of new attachments. The grinding machine (listed as the firm's No. 4 type) was set up to grind an armature shaft component on four stepped diameters, removing 0.005 to 0.006 in. of stock in two cuts within a tolerance of 0.0003 in. Workpieces are fed from a vertical magazine into an automatic synchronized loading attachment, actuated by a pilot air valve operated from a cam on the infeed mechanism. This valve initiates the return of the overhead carriage which, when grinding is completed, conveys the work from the wheels onto a size-gaging block mounted on a cross-slide. Simultaneously, the previous piece is ejected from the gage block into the delivery tray. The cross-slide then brings forward a new component from the magazine, and the overhead carriage transfers it to the grinding position between the wheels. Meanwhile, the slide returns to pick up the next component. The machine is fitted with a Sigma automatic gaging unit, which controls automatically the feed adjustment needed to correct any out-of-gage work within the allowable tolerance. If the work falls below the lower limit of tolerance, the machine stops. Wheel dressing is also automatic and can be regulated by a preset counterdevice to operate after a certain number of pieces have been ground. The infeed motor is then stopped with the aid of a magnetic brake and the two-speed truing motor makes its first pass, with coarse feed, across the grinding wheel. The return movement is made with a fine feed. The diamond quill then advances the diamond by a predetermined amount. The grinding-wheel head advances automatically to the correct position for producing a workpiece with the required tolerance, the infeed motor restarts and initiates the loading cycle, and the countermechanism is automatically reset to zero. The positioning of the wheel head after dressing is controlled by a pair of sensing jets, mounted on a compound slide and located between the grinding and control wheels. One jet senses position off the control wheel and the other off the grinding wheel. They are adjustable in relation to each other.

The B.S.A. No. 48 single-spindle automatic screw machine is a standard model, suitable for loading either from a magazine or through the spindle, and has a range of spindle speeds from 166 to 7370 rpm. The machine demonstrated was set up for the production of burner jets from $^{3}/_{16}$ hexagon brass, which involved drilling a jet orifice of 0.0154 in. maximum diam and inspecting it automatically by an electro-pneumatic Sigma unit. A transfer arm picked up each jet as it was parted off and placed it on a sealed seating in a pressure plate. A blast of air was then directed through the orifice. If the bore was obstructed, the back pressure created caused the Sigma unit to operate a solenoid and knock out the backshaft clutch.

Centerless grinder, B.S.A. No. 4, fully automatic, with a production rate of 450 operations per hour. Circular insets: *left*, automatic synchronized loading attachment; *right*, mechanism for automatic advance of diamond quill at each end of the truing stroke.

Single-spindle automatic screw machine, standard model B.S.A. No. 48, loads from a magazine or through a spindle, has spindle speeds from 166 to 7370 rpm. Circular insets: *left*, rear view showing motor drive for countersink attachment; *right*, the tooling area.



ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Heat Transfer

Quasilinear Heat Flow, by N. E. Friedmann, Litton Industries, Beverly Hills, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-10** (in type; to be published in Trans. ASME; available to June 1, 1958).

Since the formulation of the equations of transient heat conduction by Fourier, solutions of these equations have been obtained mostly by treating thermal properties as temperature independent. In those instances for which temperature changes are small, and property changes are correspondingly small, comparison between the predictions of a constant-property theory and experiment have indicated that the constant-property simplification is justified. When temperature changes are large, material-property variations with temperature, in general, cannot be neglected. As a result, the usual constant-property theory is replaced by one in variable properties.

At present, only a few particular results of a variable-property theory are available for quantitative comparison with either experiment or the constant-property theory. In spite of the few such comparisons which have been made, one conclusion is outstanding: Under conditions in which property changes are large, analytical solutions obtained from the variable-property theory differ significantly from their constant-property counterpart. The differences between the two theories are particularly pronounced at short times after the onset of heating or cooling.

The influence of variation (with temperature) of thermal conductivity, density, and heat capacity at constant pressure on the solutions of the heat-conduction equation is considered in this paper. Several problems are solved by analog computation for materials whose properties vary linearly with temperature, and the solutions of these are compared to analytical solutions. Analytical solutions also are obtained for problems involving materials which exhibit power-function-property variations with temperature. In all cases considered, the effects of property changes on calculated temperatures are found to be significant.

The Effectiveness of Stub Fins as Determined by the Teledeltos Paper Analog, by F. Landis, Assoc. Mem. ASME, and T. Zupnik, New York University, New York, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-20** (multilithographed; available to June 1, 1958).

The use of the Teledeltos dry electrical recording paper analog is extended to cover problems involving heat conduction with convective boundary conditions. The analog is used to predict the effectiveness of two-dimensional stub fins.

Teledeltos paper of a nominal resistivity of 2000 ohms/in/in. was selected and isotherms were drawn with silver paint, maintaining a paint film resistivity of about 1–2 ohms/in/in. The model was cut in the lengthwise direction from the center of the paper roll, and 1 in. × 5 in. sample check strips were cut from the roll immediately adjoining the model. Forty to sixty convective slit strips, each $^3/_8$ in. wide and about 1 in. long, were silvered and connected to radio resistances and wire-wound potentiometers, which were set to the desired external strip resistance within 0.2 per cent. All resistance measurements were made with a Wheatstone bridge.

In order to insure reproducible readings and avoid damage to the paper, the following precautions had to be employed:

Current densities were maintained below 500 mu amp per in., requiring a sensitive external light beam galvanometer in the bridge circuit.

Check strip resistance measurements were made at the time of each model reading, to account for the resistivity changes due to moisture or temperature variations, which amount to as much as 5 per cent.

The results presented show that the effectiveness of a stub fin will always be below the value computed by the one-dimensional thin-fin analysis. Results for stubby rectangular and triangular fins are presented in this paper. Comparison of analog results with the exact analytical solutions shows that with proper care the Teledeltos analog can be used to determine temperatures, heat-flux distributions, and shape factors with an accuracy of better than ±2 per cent in most practical cases. The paper concludes with additional illustrations where this analog extension can be utilized effectively.

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The Influence of Gradient Temperature Fields on Thermocouple Measurements, by N. R. Johnson, A. S. Weinstein, Assoc. Mem. ASME, and F. Osterle, Assoc. Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-18** (multilithographed; available to June 1, 1958).

In the initial phases of research work concerning the simultaneous diffusion of energy and momentum for turbulently mixing air streams, now being completed at Carnegie Institute of Technology, instrumentation problems were encountered involving design of thermocouples which would be sufficiently accurate when sensing temperatures in a gradient temperature field. When some preliminary observations showed that the error caused in these readings by conduction of heat along the wires from the thermocouple bead could become quite appreciable, the problem appeared to warrant analysis beyond the scope of the turbulent diffusion project.

The essential problem is to determine what temperature a thermocouple will indicate (assuming the electromotive force indication has a known correspondence to the bead temperature), given the temperature distribution in the fluid in contact with the bead and leads. The difference between this bead temperature and the fluid temperature in its immediate neighborhood is the temperature error. Subject to the following major assumptions, the problem is one of steady-state heat transfer with combined conduction and convection:

1 Radiation is neglected, unless it is desired to reinterpret the convection coefficient, h, as a combined convection-radiation coefficient.

2 The thermocouple bead has a uniform temperature.

3 The system is in a steady state.

In order to carry out a solution, it is necessary to write a heat balance for a differential element of wire. If the

stream temperature is given, and appropriate boundary conditions are imposed, the solution can be effected. In particular, the bead temperature, and hence the error in the indicated temperature can be determined. To maintain generality, the stream temperatures are expressed dimensionlessly.

Several basic gradient shapes, which should be a reasonable approximation to many practical solutions, have been investigated; corresponding expressions for temperature error have been presented in tabular and graphical form. Also studied was a configuration where the lead wires are brought some distance upstream, bent around, and brought back downstream; corresponding error expressions for the basic gradient shapes have been tabulated, as well as values for the critical bead distance which will eliminate the error for a given gradient.

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Development of Ceramic Insulating Materials for High-Temperature Use, by W. D. Kingery and J. D. Klein, Massachusetts Institute of Technology, Cambridge, Mass., and M. C. McQuarrie, Pennsylvania State University, University Park, Pa. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-15** (in type; to be published in Trans. ASME, available to June 1, 1958).

Factors affecting the thermal conductivity of ceramics in the temperature range from 2200-4000 F are considered from the point of view of high-temperature insulation. The effective conductivity of solids and pores over a wide range of temperatures is analyzed. Particular attention is devoted to the effects of structure and phase distribution. This analysis is related to the development of optimum properties in thermal insulation for the temperature range considered.

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Bubble Growth Rates in Boiling, by Peter Griffith, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-2** (in type; to be published in Trans. ASME; available to June 1, 1958).

The conditions determining the growth rate of a bubble on a surface in boiling are considered and a mathematical model framed in the light of these conditions. The growth rate is then calculated for bubbles growing under a range of conditions of pressure, wall superheat, and bulk fluid temperature. The average growth rate of a bubble is found to decrease with increasing maximum size and to decrease with increasing pressure. At high pressure, the maximum size of the bubble is found to be independent of pressure and primarily a function of the thickness of the superheated layer near the surface.

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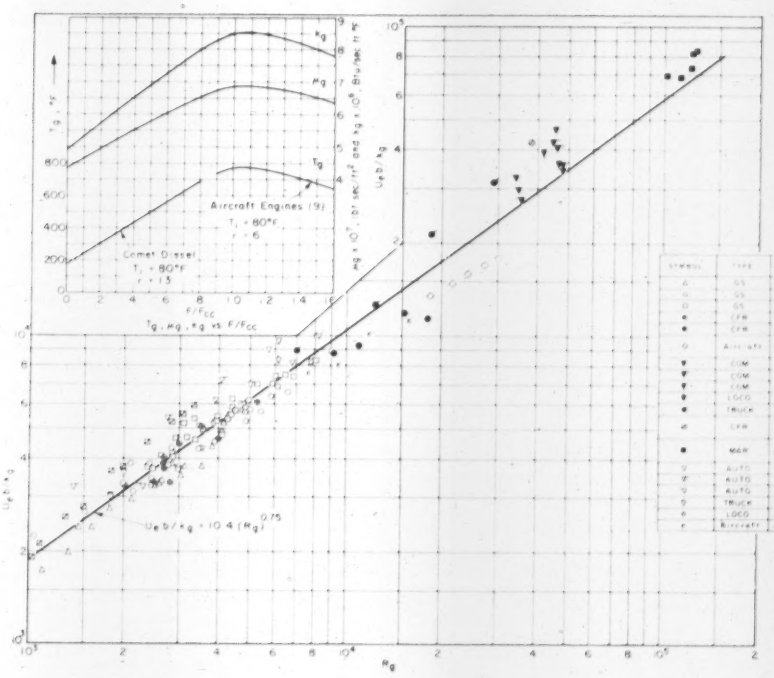
Heat Transfer in Internal-Combustion Engines, by C. F. Taylor and Tau-Yi Toong, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-17** (multilithographed; available to June 1, 1958).

Effective cooling of the cylinder walls of an internal-combustion engine is essential, not only from considerations of structural strength and stiffness but also from those of reliability in performance. Failures due to improper lubrication and abnormal combustion (combustion with preignition of detonation) are believed in many cases to be caused by overheating. Excessive cooling of the cylinder walls, however, also leads to corrosion and reduction of thermal and mechanical efficiency. It is thus apparent that a rational study of the problem of heat transfer in internal-combustion engines is very important.

In this paper the problem of heat transfer in internal-combustion engines has been studied by correlating the measured rates of heat transfer to the coolant in a manner analogous to those obtained for forced convection in simple steady-flow systems.

The experimental investigation was conducted on four engines, three of which are the M.I.T. geometrically similar, spark-ignition engines, and the fourth is a Comet-head CFR diesel engine. Mean effective gas temperatures and heat-transfer coefficients are defined and measured on the basis of a one-dimensional heat-transfer model. Typical forms of Nusselt and Reynolds numbers are found to correlate the engine heat-transfer data fairly well.



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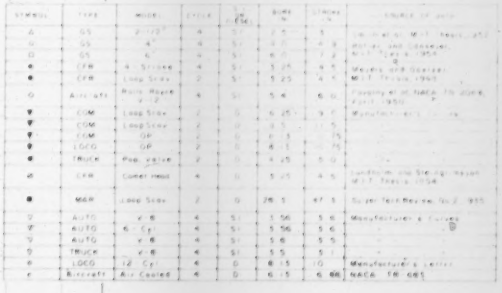

Engine over-all Nusselt number versus gas side Reynolds number for commercial engines. This figure should furnish a means of estimating the heat flow to the jackets of new designs, or of existing designs under new circumstances.

The method presented here has been extended to correlate heat-transfer data obtained for commercial engines of different sizes and types, including spark-ignition and compression-ignition engines as well as four-stroke and two-stroke engines. A curve of Nusselt number formed on the basis of the over-all heat-transfer coefficient versus a Reynolds number, based on gas flow and mean gas characteristics, is found to give a better prediction of engine heat loss than previously suggested methods.

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On the Stability of Boiling Heat Transfer, by Novak Zuber, University of California, Los Angeles, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-4 (in type; to be published in Trans. ASME; available to June 1, 1958).

DEVELOPMENTS in nuclear reactors and rocket engines, where exceedingly high heat quantities are transferred in comparatively small areas, have focused attention on boiling as a mode of transferring heat at high-flux densities.

There exist three types of boiling, namely, nucleate, transition, and film boiling. The transition from one type to another is accompanied by marked changes in the hydrodynamic and thermal states of the system. Nucleate boiling starts when the temperature of the surface exceeds the saturation temperature by a few degrees. Next to the solid surface a thin layer of superheated liquid is then formed in which bubbles nucleate and grow from some preferred spots. In nucleate boiling a temperature increase is accompanied by a sharp increase of the heat flux and of the bubble population. The spots where bubbles originate become more numerous until a critical temperature is reached at which a maximum heat flux is attained. At that point the bubbles are so numerous that they interfere with each other. If the temperature is increased beyond the critical value by a few degrees the transition boiling begins. Westwater and Santangelo have found that in this region no liquid-solid contact exists. The surface is blanketed by an unstable, irregular film of vapor which is in violent motion. A further increase of the temperature of the surface is followed by a decrease of the heat flux until a minimum value is reached at which a stable film is formed. The stable film boiling is characterized by an orderly discharge of large bubbles with a regular frequency and at regular intervals. In the film-boiling region, the heat flux increases with an increase of temperature, but at a much slower rate than in nucleate boiling. Consequently, at high heat-transfer rates the temperature of the heating surface can exceed the melting temperature and "burnout" occurs. It is therefore of great practical interest to operate in the nucleate region, whence it is of theoretical and practical interest to investigate nucleate boiling and the conditions leading to the changes in the boiling process.

Boiling heat transfer in the nucleate region is reviewed in this paper. The transition film-boiling region is analyzed by considering the stability of a plane vortex sheet separating two inviscid fluids. Using the classical results of Helmholtz, Kelvin, and Rayleigh, expressions have been derived that predict the maximum and minimum heat-transfer rates in the nucleate and the film-boiling regimes, repectively. The model exhibits the essential features of the phenomenon and shows good agreement with experimental data.

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The Correlation of Nucleate Boiling Burnout Data, by Peter Griffith, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-21 (multilithographed; available to June 1, 1958).

A DIMENSIONLESS correlation is developed for nucleate-boiling burnout data including the following ranges of variables:

1 Fluids—water, benzene, n-heptane, n-pentane, and ethanol.
2 Pressure—0.0045 to 0.96 of critical pressure.
3 Velocity—0 to 110 fps.
4 Subcooling—0 to 280 F.
5 Quality—0 to 70 per cent.

The data are drawn from a variety of sources and have been collected on widely varying types of systems. Over 300 points are correlated with 94 per cent of the points included between the ±33 per cent envelope drawn around the best line through the points. The correlation includes only fluid properties and quantities which can be calculated on the assumption of equilibrium conditions at the burnout point.

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Experimental and Analytical Study of Two-Component Two-Phase Flow in an Ejector With Condensation, by Joseph Kaye, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass., and M. A. Rivas, Jr., Assoc. Mem. ASME, Caracas, Venezuela, S. A. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-35 (multilithographed; available to une 1, 1958).

STUDIES of a simple jet pump with two-component two-phase flow of air, steam, and water, with simultaneous heat-transfer and mass-transfer processes, are presented and discussed. It is shown that 2C-2P flow of air, steam, and water is analogous to simpler compressible flows and that normal shocks should occur in this type of flow. A simplified flow model for 2C-2P flow is presented, based on local thermodynamic equilibrium, and this model is used to predict quantitatively the pressure rise in a normal shock in 2C-2P flow. The experimental results obtained from a jet pump confirm the predictions of normal shocks in 2C-2P flow. The predicted and measured values of the pressures after the shock agreed within 10 per cent for the case where the experimental inlet stagnation conditions conformed to the design specifications of this jet pump. The predicted and measured values of the pressures after the shock disagreed by about 20 to 30 per cent for the case where the experimental inlet conditions corresponded to an off-design operation of this jet pump.

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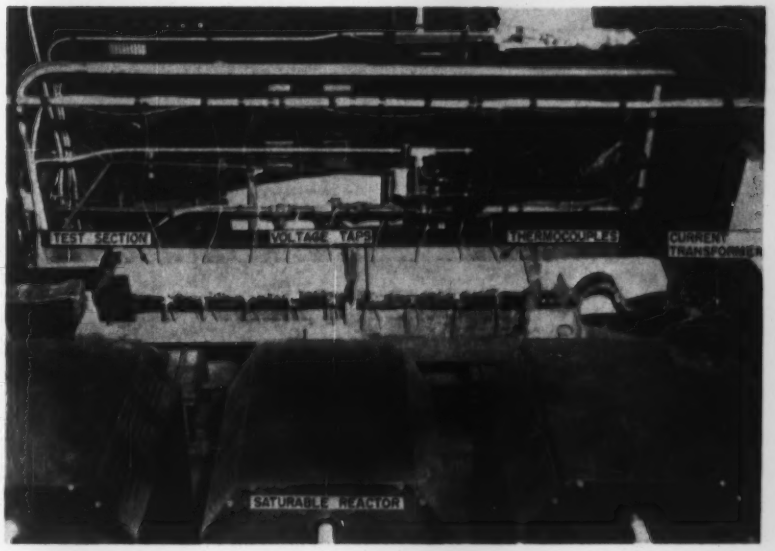
Heat, Mass, and Momentum Transfer in Flow Through Porous Media, by L. Green, Jr., Assoc. Mem. ASME, Aerojet-General Corporation, Azusa, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-19 (multilithographed; available to June 1, 1958).

EFFORTS at correlation of data on heat transfer, mass transfer, and fluid friction in flow through porous media are reviewed, and it is noted that the problems encountered in such correlations appear to center around proper evaluation of the characteristic length for the porous structure which enters into the Reynolds number expressing the balance between inertial and viscous effects in the flow system. It is emphasized that, in general, this length cannot be evaluated *a priori* by inspection of the medium, but is the ratio of two independent length parameters which are required for complete characterization of a complex porous structure.

Application of the two-parameter method for correlation of data on heat, mass, and momentum transfer in porous media is investigated, using the few published experimental data which permit determination of the two parameters. An encouraging degree of unification is observed, and it is suggested that more precise heat-transfer measurement may establish a unique relationship between the fluid friction and heat transfer in porous media. A correction apparently neglected in applications of the "transient" technique for determination of heat-transfer coefficients is noted.

Heat Transfer to Supercritical Water, by N. L. Dickinson, Assoc. Mem. ASME, and C. P. Welch, Assoc. Mem. ASME, The Babcock & Wilcox Company, Alliance, Ohio. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-7 (in type; to be published in Trans. ASME; available to June 1, 1958).

HEAT-TRANSFER coefficients for supercritical water are presented for flow in an electrically heated AISI Type 304 stainless-steel tube having an inside diameter of 0.300 in. Bulk fluid temperatures were varied from 220 to 1000 F at 4500 psi, and over a more limited temperature range at 3500 psi. Mass flows tested include 1.6 to 2.5 $\times$ 10^6 lb/hr-sq ft, and a flux range of 280,000 to 580,000 Btu/hr-sq ft was covered. Values of film conductance in the vapor region were found to be substantially higher than those predicted by extrapolation of data found in the literature, or by recent formulas based on a theoretical approach. These findings are of special interest to the boiler industry which is presently designing units for use at supercritical conditions.



Insulated test section for studies of heat transfer to supercritical water consists of an electrically heated AISI Type 304 stainless-steel tube having a 0.540-in. OD and a 0.300-in. ID. Water or steam was supplied to the tube from a small once-through single-tube steam generator.

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A New Method of Heat-Exchanger Design With Specified Inlet and Outlet Conditions, by R. S. Fairall, Garrett Corporation, Los Angeles, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-5 (in type; to be published in Trans. ASME; available to June 1, 1958).

IN ORDER to arrive at an optimum design of a heat exchanger a new method of design has been developed, which enables the effect of a change in independent variables to be studied while the dependent quantities are held constant. Thus, for example, a designer might wish to hold all quantities constant except hot-side pressure loss and heat-exchanger hot-flow length; then, by systematically varying the hot-side pressure loss, the effect on flow length could be observed.

A few years ago the practical value of this design method might have been questioned owing to the large number of calculations required to optimize even a simple unit. However, modern high-speed computers require only a few minutes to find the solutions for a few hundred cases. To illustrate, an IBM computer was utilized to find the conditions which would yield a heat exchanger of minimum volume. The problem was solved successfully in 1 min and 20 sec of machine time; approximately 200 cases were computed.

A separate set of equations must be used for each type of flow. The four most common types are analyzed here: counterflow, parallel flow, crossflow, and two-pass cross-parallel flow. One of these cases, crossflow, is analyzed for the condition of minimum wall temperature and minimum volume. There are many other types of flow in use which merit similar analysis (shell-and-tube units have a great number of possible flow patterns). It is hoped that this paper may stimulate interest in this potentially profitable field and new analyses will appear.

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Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part II, by V. S. Arpaci, Massachusetts Institute of Technology, Cambridge, Mass., and J. A. Clark, University of Michigan, Ann Arbor, Mich. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-6 (in type; to be published in Trans. ASME; available to June 1, 1958).

THE dynamic response of heat exchangers having time variant internal sources is the subject of a series of papers. The first of these papers (see September, 1957, issue of MECHANICAL ENGINEERING, p. 880) reported the results of analysis and experiment on the dynamic response of the coolant temperature in this type of heat exchanger as a function of both time and space.

This paper considers the dynamic response of the temperature of the heat-transfer surface and the fluid-surface temperature difference in a heat exchanger having internal heat sources which is subjected to a sudden change in the rate of heat generation. The results are obtained by a direct mathematical attack on the governing differential equations. These are presented such that the surface temperature may be computed as a function of space and time using three mathematical functions obtained by IBM machine reduction. The theory is compared with experimental measurements and favorable agreement is obtained. Heat exchangers to which the solutions apply include the heterogeneous nuclear reactor.

●

A Study of Heat Transfer and Pressure Drop Under Conditions of Laminar Flow in the Shell Side of Cross-Baffled Heat Exchangers, by F. L. Test, Assoc. Mem. ASME, University of Rhode Island, Kingston, R. I. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-3 (in type; to be published in Trans. ASME; available to June 1, 1958).

THIS paper discusses a study of the laminar region and develops heat-transfer and pressure-drop correlations for an effective Reynolds number below 100. The principal variables were oil-weight rate, mean oil temperature, mean water temperature, and baffle spacing. All runs were performed with an SAE 60 and an SAE 30 oil. An increase in baffle spacing would increase the rate of heat transfer and decrease the pressure drop, particularly at low oil flows. A change in the mean oil temperature had very little effect on the oil-film coefficient of the SAE 60 oil. The oil-film coefficient would change very rapidly with mean water temperature.

The heat-transfer and pressure drop results are correlated on the basis of an effective Reynolds number. The effective Reynolds number is a function of the effective area which accounts for various leakage passages. The correlations predict results that rarely differ by more than 10 per cent from the experimental results.

●

Modes of Adiabatic and Diabatic Fluid Flow in an Annulus With an Inner Rotating Cylinder, by Joseph Kaye, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass., and E. C. Elgar, Canadian General Electric Company, Toronto, Canada. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-14** (in type; to be published in Trans. ASME, available to June 1, 1958).

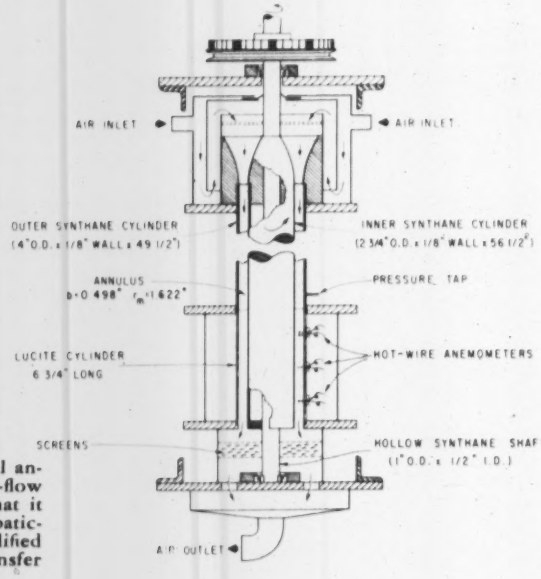
THIS report is the first phase of an investigation of those variables which control the rate of heat transfer in the air gap of a rotating electrical machine. This phase of the problem reduces to obtaining a basic understanding of the fluid-flow and heat-flow processes in an annulus, formed by two concentric cylinders, with the inner cylinder rotating and with the outer cylinder stationary. The primary independent variables and effects are, first, the axial velocity of the air through the air gap, which is combined with other variables to form the customary Reynolds number; second, the speed of rotation, which is combined with other variables to form a new dimensionless group, called the Taylor number, in honor of G. I. Taylor, who laid the theoretical and experimental foundations for this problem; third, the temperature gradients at the walls; fourth, the surface roughness in the air gap; and finally, the "entrance effects" introduced by the development of the boundary-layer flow in the air gap.

The present report gives the experimental results obtained for two smooth and long annuli, thereby eliminating from consideration, at present, the last two effects given above. It is shown that four distinct modes of flow exist for adiabatic and diabatic flow of air in these annuli. The demarcation lines of these flow regions were investigated in detail for adiabatic flow with hot-wire anemometers and also by means of visual and photographic methods.

The results showed that four modes of flow exist over regions of Reynolds number and Taylor number for both adiabatic and diabatic flow. These modes are: (*a*) purely laminar flow; (*b*) laminar flow plus Taylor vortexes; (*c*) purely turbulent flow; (*d*) turbulent flow plus vortexes.

The results obtained here for adiabatic flow were found to agree well with the work of Cornish for the boundary line between the regions of laminar flow and laminar-plus-vortexes flow, but they did not agree with similar results by Fage.

Preliminary results are also presented here for diabatic flow in the annulus in the form of heat-transfer coefficients. These results are shown in the form of a three-dimensional surface in which the Nusselt number is represented as a function of the Reynolds number and Taylor number.



Details of long vertical annulus for adiabatic-flow studies designed so that it could be used for adiabatic-flow studies and modified easily for heat-transfer studies

Heat Transmission to Fluids With Low Prandtl Numbers for Flow Through Tube Banks, by R. D. Cess, Westinghouse Research Laboratories, Pittsburgh, Pa., and R. J. Grosh, Assoc. Mem. ASME, Purdue University, Lafayette, Ind. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-12** (in type; to be published in Trans. ASME; available to June 1, 1958).

SOLUTIONS for the over-all Nusselt number, previously obtained by the authors for the flow of a fluid with a low Prandtl number about a single cylinder, have been extended to include the case of flow through a bank of tubes. A conducting sheet analogy was used to determine the flow field through the tube banks, assuming inviscid irrotational flow, and solutions for the over-all Nusselt number were obtained for four basic tube-bank geometries. Various heat-flux and temperature distributions were considered for the surface of the tubes.

A comparison of the analytical results with experimental results for mercury flowing through a staggered tube bank was made; the comparison showed a very good correlation between theory and experiment for moderate fluid velocities. For high velocities the theory will give low results as could be expected from the assumption that eddy conduction is negligible.

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Heat-Transfer Rates to Cross-Flowing Mercury in a Staggered Tube Bank—II, by C. L. Richards, Assoc. Mem. ASME, General Dynamics Corporation, San Diego, Calif.; O. E. Dwyer, Brookhaven National Laboratory, Upton, N. Y.; and D. Dropkin, Cornell University, Ithaca, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-11** (in type; to be published in Trans. ASME; available to June 1, 1958).

AS PART of a continuing liquid-metal heat-transfer program at the Brookhaven National Laboratory, both local and tube average heat-transfer coefficients have been obtained for the flow of mercury normal to a staggered tube bank. The bank consisted of sixty $^1/_2$-in. tubes, six wide and ten deep, arranged in an equilateral-triangular array. The paper presents results showing the effects of flow rate, Prandtl number, wetting, gas entrainment, and tube location on the tube-average coefficients. The angular variation of the local coefficient is not considered here, owing to the fact that the values have not been calculated completely from the original data. The mercury results are compared with a few results obtained with water in the same equipment. The heat-transfer runs cover the Reynolds number range of 20,000 to

200,000, whereas the water runs cover the range 8000 to 20,000. Pressure-drop results for both water and mercury flow through the tube bank are reported also. The mercury coefficients for tubes in the interior of the tube bank are well represented by the equation

$$Nu = 4.03 + 0.228(Pe)^{0.67}$$

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Combined Free and Forced Convection in a Constant-Temperature Vertical Tube, by T. W. Jackson, Mem. ASME, W. B. Harrison, and W. C. Boteler, Georgia Institute of Technology, Atlanta, Ga. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-13** (in type; to be published in Trans. ASME; available to June 1, 1958).

An experimental study of superposed free and forced convection for air in a vertical tube is examined. The Nusselt modulus, based on the log-mean-temperature difference, ranged from 15.0 to 57.1; the Graetz modulus, based on the bulk or average temperature of the air, ranged from 40.2 to 1710; and the Grashof-Prandtl D/L modulus, based on properties of air at the wall temperature, ranged from 1.05×10^5 to 1.30×10^3. The Martinelli equation for heating fluids flowing vertically upward does not correlate the data satisfactorily. An analysis of the system from a macroscopic viewpoint leads to the derivation of an equation which fits the experimental data.

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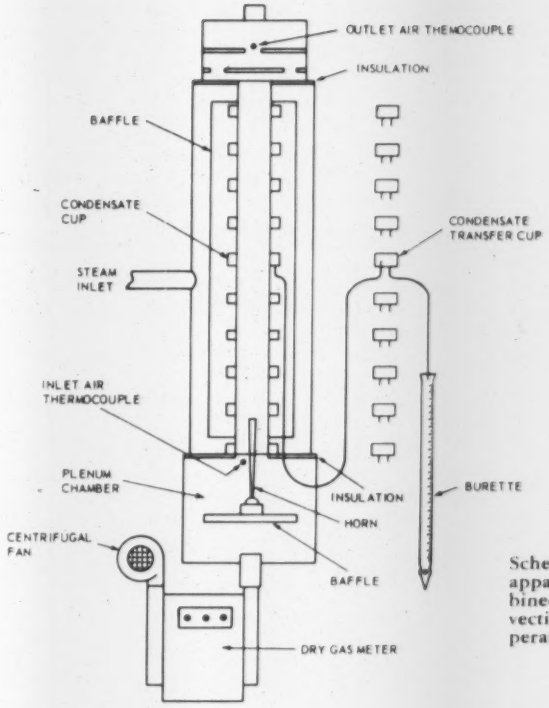
Heat Transfer in Liquid Metals, by P. S. Lykoudis and Y. S. Touloukian, Mem. ASME, Purdue University, Lafayette, Ind. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-16** (in type; to be published in Trans. ASME; available to June 1, 1958).

The problem of heat transfer in liquid metals is studied for the case of a fully developed turbulent flow in cylindrical pipes of constant diameter, the fluid under consideration being heated (or cooled) by a constant and uniform heat input at the wall. In the analysis, the similarity theory between heat and momentum transfer is used. A theory is presented which gives the ratio of eddy diffusivities for heat and momentum transfer as a function of the Prandtl modulus. It is shown that heat transfer in liquid metals can be analyzed universally in terms of a dimensionless parameter called the "generalized Peclet modulus" and defined by the relation

$$N_{Pe}^* = (N_{Re}^*)(N_{Pr}^*) = [N_{Re}(f/2)^{1/2}](N_{Pr}\sigma)$$

Temperature profiles are presented and the limiting cases for $N_{Pr} = 0$ are studied.



Schematic of experimental apparatus for study of combined free and forced convection in a constant-temperature vertical tube

Heat-Transfer Studies of Naval Boilers, by L. Cohen and W. A. Fritz, Jr., Naval Boiler and Turbine Laboratory, Philadelphia, Pa. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-8** (in type; to be published in Trans. ASME; available to June 1, 1958).

During World War II the double-furnace superheat-control type boiler was the prevailing type used on combatant ships. It operated at a pressure of 575 psig and temperature of 850 F. These boilers presented two serious operational difficulties: Adaptation of relatively simple automatic control systems for double-furnace operation; and maintenance of sufficient steam flow through the superheater to coincide with firing rates in the superheater furnace. Because of these and other difficulties associated with size and weight requirements, postwar naval boilers were predominantly the single-furnace integral super-heater type.

In single-furnace boilers all steam generated flows through and gases of combustion flow over the superheater. There are no positive means of superheat control such as dampers and attemperators, but steam temperature at superheater outlet may be varied by changing combination of lighted-off burners, amount of excess air, or temperature of feed. These or other changes of a similar type generally have a small effect upon final steam temperature and additionally affect cycle and operating efficiencies. Therefore it is imperative that these integral superheater boilers be designed to provide a required superheat temperature. These temperatures should be constant over as wide a range of rate as possible. Boilers that range in pressure from 600 to 2000 psig and temperature from 800 to 1050 F have been tested.

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Heat Transfer to Flow in a Round Tube With Arbitrary Velocity Distribution, by I. R. Whiteman, University of California, Los Angeles, Calif., and W. B. Drake, Lockheed Aircraft Corporation, Van Nuys, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-1** (in type; to be published in Trans. ASME; available to June 1, 1958).

Though the velocity distribution of a fluid passing through a circular tube in streamline motion may be determined rather easily, it is much more difficult to evaluate the heat flow to such fluid from the wall, when the wall is kept at uniform temperature and the fluid enters the tube at a different temperature. The problem has only been solved neglecting the variations of the thermal properties of the fluid with temperature.

In honor of L. Graetz (1885), who first found a mathematical solution, this problem is generally referred to in his name.

Since many such problems which occur in physical reality have velocity distributions other than that of a parabolic shape, it is desirable to expand upon the Graetz solution to include other possible velocity-distribution profiles.

An extension of the classical Graetz problem is presented in this paper to cover various velocity profiles; and the variation of Nusselt modulus with respect to these profiles is shown.

Gas-Friction—Heat Transfer Charts for Ducted Flows, by S. V. Manson, Curtiss-Wright Research Division, Clifton, N. J. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-34** (in type; to be published in Trans. ASME; available to June 1, 1958).

For ducts that have equal and parallel end areas, one-dimensional end flows, and negligible natural convection in the flow direction, it can be shown that the fluid end ratios and the parameter

$$\gamma_1 \left(\frac{f'}{2} \frac{S}{A} \right)$$

are uniquely determined, where:

γ = ratio of specific heat at constant pressure to specific heat at constant volume, dimensionless

f' = friction factor based on arithmetic average density, dimensionless

S = friction surface in duct interior, sq ft

A = flow area at duct entrance, sq ft

This is so when M_1, T_2/T_1, and P_2/P_1 are specified without regard to temperature path, internal geometry, or fluid-flow structure. M is Mach number, T is the temperature, and P the pressure. The numbers 1 and 2 refer to the entrance and exit, respectively.

Petroleum

The Peace River and Alaska Highway Gas-Gathering System, by A. L. Berry, Westcoast Transmission Company, Ltd., and B. L. Moreau, Pacific Petroleums Ltd., Calgary, Alberta, Canada. 1957 Joint ASME Engineering Institute of Canada Meeting paper No. **57—ASME-EIC-2** (multilithographed; available to April 1, 1958).

One of Canada's most extensive natural-gas gathering systems is rapidly nearing completion. The system is designed to fill the requirements of the Westcoast Transmission Company's 650 mile-long, 30-in-diam pipeline originating at Taylor, British Columbia, where the Alaska Highway crosses the Peace River, terminating at Huntingdon on the International Boundary just east of Vancouver.

In addition to its 30-in. transmission line, Westcoast Transmission Company is constructing approximately 130 miles of main gathering lines ranging in sizes from 12 to 26 in. The producers, primarily Pacific Petroleums Limited and Associates, are constructing 80 miles of field gathering lines ranging in sizes from 4 to 12 in., in the seven major gas fields to be connected initially. The gathering system will have an initial capacity of 400 million cu ft per day, to match the initial designed capacity of the Westcoast Transmission line, and will be capable of expansion as additional gas is required. The over-all cost of the project will approach $200 million including main transmission lines, processing and gathering facilities.

Approximately 25 per cent of the initial throughput will be required for sales in the Caribou, Okanagan, and Kootenay areas and in the lower Fraser district and City of Vancouver. The remaining 75 per cent of the initial throughput will be delivered at Sumas, Wash., across the border from Huntingdon, B. C., for transmission to the Northwestern United States. No unusual pipeline construction problems are anticipated since the route is almost completely free of rock and muskeg, through rolling terrain varying from open farm land to moderately heavy timber.

The southeastern extension is a dry sweet-gas gathering system of conventional design, whereas the northwestern extension is essentially a wet sour-gas gathering system with many new and interesting features.

The system is described in this paper and the gas-handling facilities between the wellhead and treating plant are discussed. Two-phase flow is used in part of the gathering system, and an empirical method of predicting pressure drop in gas condensate pipelines is outlined.

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Automatic Computing for Process-Unit Operating Guides, by H. F. Moore, Mem. ASME, Esso Research and Engineering Company, Linden, N. J. 1957 Joint ASME Engineering Institute of Canada Meeting paper No. **57—ASME-EIC-1** (multilithographed; available to April 1, 1958).

Computers of the intricate, large-scale, central-office type are currently being used in the oil industry to determine how best to run individual processing units and complete refineries. The extension of computer use to continuous service directly on a unit is a large step that will require considerable development. It is shown that fairly simple computers may be used directly on the operating unit to compute important operating variables that cannot be measured directly, but which can be computed from other measurements—an example is furnace efficiency.

Eleven "operating guides," for fluid catalytic-cracking plants, are discussed. The eleven operating guides for one of the two catalytic-cracking plants now being implemented are:

1 Carbon burning rate, pounds per hour. This computed variable indicates to the operator how much carbon, which is deposited on the catalyst during the cracking reaction in the reactor, is being burned off in the regenerator.

2 Catalyst circulation rate. The CO_2 rate, CO rate, air rate, and flue gas rate are separately calculated and held in storage for use in two or more of the operating guides.

3 Catalyst-to-oil ratio. This is the weight ratio between catalyst circulation rate and oil-feed rate to the reactor.

4 Ratio of weight of oil fed to reactor per unit time to weight of catalyst in the reactor. This is a measure of contact time between oil and catalyst.

5 Per cent conversion of heavy feed oil to gasoline. The feed stream is measured directly. The gasoline material is computed from flow measurements on product and intermediate streams.

6 Amount of hydrogen in coke. This is a measure of the efficiency of the stripper at the bottom of the reactor, where the oil is stripped from the coked catalyst as it is moved from the reactor to the regenerator.

7 Total carbon make, per cent of feed. This is an important variable that is a measure of the effectiveness of the cracking reaction. The goal is to produce a maximum of cracked material with a minimum of carbon.

8 Heat duty of fractionator top pump around stream. Duty-flow rate × specific heat × (temperature out minus temperature in) × constant.

9 Heat duty of fractionator top pump around stream. Similar to 8.

10 Regenerator superficial velocity. This is a measure of velocity of gases through the regenerator.

11 Reactor superficial velocity. Same as 10; for the reactor vessel.

Metal Processing

Floturn—A Production Process as Well as a Development, by C. L. Sporck and W. H. Busch, The Lodge & Shipley Company, Cincinnati, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-98** (multilithographed; available to April 1, 1958).

FLOTURN is a trade name of the Lodge and Shipley Company, Cincinnati, Ohio. The Floturn process is a highly accurate means of forming sheet metal into such shapes as cones and cylinders. The method is basically a cold rolling process in which the displacement of metal is parallel to the center line of the part being formed. This differs from the displacement in the cold rolling mill which moves the metal in a longitudinal direction, but this method displaces the metal in a spiral manner as the work revolves. This movement of the metal is produced by the action of the roller against the blank to be formed which in turn is backed up by the mandrel. The roller is actuated either by mechanical or hydraulic forces.

In this method the metal is obtained from the thickness of the blank instead of from the diameter of the blank as in the spinning and drawing processes. These processes, in the course of operation, change the diameter of the blank and form the finished part from the volume of metal in the outer diameter. The Floturn process uses the thickness of the metal to obtain the volume and displace it parallel to the center line so that the original perimeter of the blank remains the same.

This method eliminates, in many instances, the complexities of welding, along with the testing of the weld, as well as the finishing which is required. By removing the weld it removes a source of error and a possible source of failure in the finished part.

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Ceramic and Carbide Tool Performance Tests—Part II, by A. O. Schmidt, Mem. ASME; B. F. von Turkovich, J. R. Roubik, Assoc. Mem. ASME, Kearney and Trecker Corporation, Milwaukee, Wis.; and I. Ham, University of Wisconsin, Madison, Wis. 1957 ASME Semi-Annual Meeting paper No. **57—SA-101** (multilithographed; available to April 1, 1958).

DATA on tool life performance of typical carbide and ceramic single-point tools have been presented in the first section of this report, ASME paper No. 56—A-218 (see February, 1957, issue of MECHANICAL ENGINEERING, p. 184). This paper considers tool forces in orthogonal turning of SAE 1015 tubing with carbide and ceramic single-point tools. It was possible to determine and establish quantitatively the factors pertinent to the mechanics of chip formation with ceramic and carbide materials at negative and positive rake angles. Tests were run at feeds of 0.005 and 0.010 ipr and at speeds of 150, 200, 300, 400, 500, and 600 fpm.

Charts were obtained which show that the cutting forces are practically identical, with carbide exhibiting slightly larger forces at low cutting speeds. The chip-thickness ratio and chip-contact areas were measured and are shown graphically relative to cutting speed. The variations of the cutting force, F_c, with rake angle are shown as a series of curves having cutting speeds as the set parameter. From the same measurements additional information was derived including graphs of the shear angle as a function of cutting speed and tabulations of coefficient of friction, shear stress, and shear strain.

Cutting temperatures for ceramic and carbide tools were determined analytically and plotted in relation to cutting speeds and rake angles.

The power consumption has also been measured and the energy, in terms of horsepower per cubic inch per minute, was computed from force measurements to provide data on the actual power requirements for both carbide and ceramic tools.

Under the same cutting conditions, ceramic and carbide tools exhibit practically the same cutting forces, specific cutting energy, manner of chip formation, and angle relationships, and these quantities are influenced in approximately the same manner by variations in cutting speed, feed, and rake angle. Larger values of cutting force, specific energy, shear strain, and cutting temperature due to shear are associated with the more blunt or negative rake angles and lower cutting speeds. Both materials show an increase in interface temperatures as rake angle is changed in the direction from negative to positive. The ceramic performed slightly better than the carbide at higher cutting speeds.

However, chip-tool contact length or area was smaller for ceramic, and both the temperature rise due to friction on the tool face and the average interface temperature were also higher for the ceramic tools than for the carbide tested under the same conditions. Smaller contact area and lower thermal conductivity for the ceramic were responsible for the higher interface temperatures.

The angle relationships were investigated and experimental values for the complete test series were found to be in fair agreement with the solution proposed by Lee and Shaffer.

Power

Characteristics of Air-Borne Particles, by T. A. Rich, General Electric Company, Schenectady, N. Y. 1957 ASME Semi-Annual Meeting paper No. **57—SA-56** (multilithographed; available to April 1, 1958).

AIR-BORNE particulates are primarily responsible for the visible effects of air pollution and contribute appreciably to the total mass of pollutants. An appreciable fraction of the particulates is submicroscopic so optical methods are not suitable for following their life history. Techniques for measuring number and average size of submicroscopic particles over wide ranges have been developed but are not widely known or used outside of the idealized setup of the laboratory.

In this paper a review is given of some of the more useful parameters of particles and methods by which these can be measured.

Indexes of size can be obtained from the properties of coagulation, diffusion, mobility, and limiting rate of fall. The sizes so obtained are strictly true for a monodisperse aerosol only; for a mixture of sizes an apparent radius is obtained which may differ from the average geometric radius.

Problems of sampling and measuring aerosols under high temperature conditions have not been completely resolved. A wider use of the techniques already available for size and numbers of an aerosol would not only throw light on some of the problems of air pollution but would certainly lead to further improvements in our knowledge of aerosols.

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An Approach to the Selection of Steam Unit Size for a Large Hydro-Steam System, by B. W. Schackelford and F. F. Mautz, Mem. ASME, Pacific Gas & Electric Company, San Francisco, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-99** (multilithographed; available to April 1, 1958).

STEAM-UNIT size and an approach to the selection of the proper size steam unit for a large hydro-steam system are discussed in this summary of a study by the Pacific Gas and Electric Company.

Review of available studies indicated the economy of larger units; however, these studies did not consider conditions comparable with those of this company's system. The integration of relatively large amounts of new hydro-electric and steam capacity is among the company's chief concerns, since the system load has doubled in the past ten years.

At the present rate of growth, it is expected that in 1967 the peak load will be on the order of $8^1/_2$-million kw, again almost doubling in ten years.

In order to make this study it was necessary to accept certain basic assumptions. The assumptions made were in the areas of: System growth rate; hydro-electric and thermal resources to be added; reserve requirements; unit sizes and steam conditions; fuel requirements and costs; capital costs; operation and maintenance costs; location of units; annual fixed charges; period of study; and capacity factor operation of new units.

It was found that substantial savings result from the change to larger units. The largest savings are realized in the change to the 275-mw and 325-mw programs, with the 450-mw program being less favorable. A decision was made to proceed with a 325-mw program based on the slightly greater savings shown over the 275-mw machines.

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Computer Applications in the Power Industry, by G. L. Way, Mem. ASME, Bechtel Corporation, San Francisco, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-102** (multilithographed; available to April 1, 1958).

THE application of modern electronic computing machines to accounting, engineering, and operations problems is complicated by the difficulties in comprehending the capabilities and limitations of the machines, the extraordinary capital costs of the equipment, and the phenomenal savings promised or reported.

This paper is an attempt to evaluate the extent to which such machines have and are presently being used in the electric-power industry and the nature and magnitude of the problems being assigned to them.

Approximately 150 privately and publicly owned electric utilities have been surveyed as to their use or intended use of both punched-card systems and computers. The companies have been selected to include from the largest down through those serving areas of approximately 50,000 population. In addition, the prominent manufacturers of component equipment for power plants and consulting engineers who specialize in power-plant design were contacted.

Hydraulics

Boundary Layer Along Annular Walls in a Swirling Flow, by H. Yeh, Mem. ASME, University of Pennsylvania, Philadelphia, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-22** (multilithographed; to be published in Trans. ASME; available to April 1, 1958).

THE development of incompressible turbulent boundary layers along concave and convex stationary annular walls is investigated analytically and experimentally for a swirling flow; that is, flow with both tangential and axial mean velocities.

Although extensive research has been made in recent years on turbulent shear flows, the majority of such work is limited to unidirectional flows—flows in which the mean velocity does not change appreciably in direction. Many interesting cases in practice fall into this class, such as channel flow, pipe flow, wake, boundary layer, and jet. There are, however, important cases in which the mean flow is continuously changing in direction. This is the flow, for example, occurring in turbomachinery.

It was found that the integral momentum equation describing this type of boundary layer contains three correction terms to the conventional equation. The combined influence of these corrections appears to promote the growth of the boundary layer next to a concave wall. Other differences between the boundary layers with swirl and those without swirl are pointed out and interpreted.

Two-Phase Flow in Rough Tubes, by D. Chisholm, English Electric Company, Harwell, England; and A. D. K. Laird, University of California, Berkeley, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-11** (in type; to be published in Trans. ASME; available to April 1, 1958).

THE flow of gas-liquid and vapor-liquid mixtures, or, two-phase mixtures, occurs frequently in industry.

This paper presents data for pressure drop and saturation during flow of air-water mixtures in smooth and rough horizontal tubes. Improvements in the two-phase flow correlations for rough tubes are presented. Approximate empirical relationships developed using these improvements correlated the majority of the data within 15 per cent.

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Stall Propagation in a Cascade of Airfoils, by A. H. Stenning, Massachusetts Institute of Technology, Cambridge, Mass.; and A. R. Kriebel, Stanford Research Institute, Menlo Park, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-29** (in type; to be published in Trans. ASME; available to April 1, 1958).

A SMALL perturbation analysis of rotating stall is presented which includes the effects of finite pressure rise across the cascade, finite blade chord, and boundary-layer time delay. The theory yields a stability criterion for the initiation of rotating stall, upper and lower boundaries for the velocity of propagation, and a possible explanation for the mechanism governing the number of stall cells. Tests on rotating stall in a cascade and two rotors suggested a vortex-shedding model for fully developed rotating stall which is not limited to small perturbations and which appears to agree closely with the observed stalling mechanism.

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Laminar Flow Over an Enclosed Rotating Disk, by S. L. Soo, Assoc. Mem. ASME, Princeton University, Princeton, N. J. 1957 ASME Semi-Annual Meeting paper No. **57—SA-28** (in type; to be published in Trans. ASME; available to April 1, 1958).

LAMINAR flow over an enclosed rotating disk was studied to reduce the inconsistency between previous theoretical and experimental results. Unlike the case of a disk in an infinite fluid medium, the friction-moment coefficient of the enclosed disk is proportional to Re^{-1} in the laminar range and $Re^{-1/4}$ in the turbulent range. The latter is accurate for the range of disk diameter to gap ratios between 200 and 50. The former correlation, instead of being an approximation according to simple shear as has been suggested, is shown to be true even when recirculation exists. The deviation from Re^{-1} relation in the laminar range is shown to be due to the inertia effect of recirculation. The significance of inertia effects in addition to that due to centrifugal force has been pointed out and corrections have been presented. Radial outflow has been shown to be more effective than radial inflow for turbine-disk cooling. It has been shown that rotation of the shroud provides an added sealing effect for a centrifugal machine.

Gas Turbine Power

Missile Auxiliary Power-Supply Development, by W. R. Chapman and T. C. Noon, Thompson Products, Inc., Cleveland, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-85** (multilithographed; available to April 1, 1958).

TURBINE-DRIVEN auxiliary power supplies for guided missiles are currently undergoing research, development, and production by Thompson Products, Inc.

Auxiliary or secondary power is required by a number of missile subsystems. A partial list of these subsystems includes: Guidance intelligence, data transmission, and warhead priming and firing.

For the purpose of discussion in this paper, the author defines an auxiliary power supply (APS) as any source of energy other than a pad-mounted power take-off. An APS system may be required in any of the following situations:

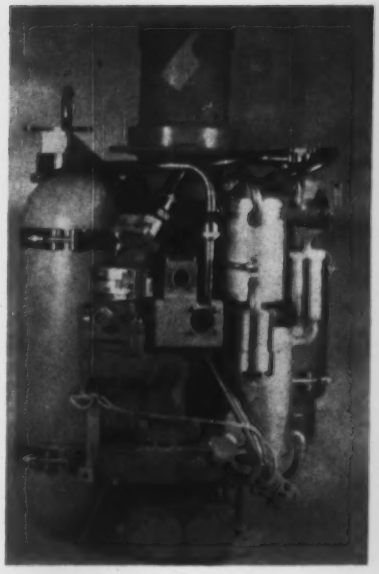
1 When a nonrotating (ramjet or rocket) type of primary propulsion system is used.

2 When self-starting of the primary propulsion system is required.

3 When the installation of the primary propulsion system is such as to preclude installation of a power take-off unit.

As missile-system characteristics require, the APS may take any one of a large number of configurations. A typical APS system must consist of an energy supply and means for converting this energy into the desired form. The typical APS configuration has its potential energy in the form of liquid monopropellant being delivered to a gas generator. In the gas generator, the monopropellant is decomposed forming hot high-pressure gases which are expanded through a turbine. The turbine drives a hydraulic pump and an alternator through a gear box. The system is controlled by sensing rotational speed and modulating the flow of monopropellant to eliminate rotation speed error. Variations on this basic configuration may occur in the energy source, or the method of energy conversion, fuel delivery, and control.

Repeated emphasis is placed on the necessity for considering the design of an APS system as one segment of the overall missile system. It is also necessary that future APS design requirements be made available in order that research and developments may be directed toward advancing the state of the art.



Auxiliary power supply (APS) system for liquid monopropellants

Machine Design

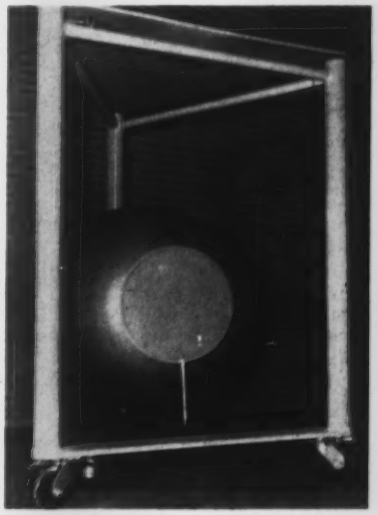
The Trifilar Pendulum and Its Application to the Experimental Determination of Moments of Inertia, G. W. Hughes, Assoc. Mem. ASME, Sandia Corporation, Albuquerque, N. M. 1957 ASME Semi-Annual Meeting paper No. **57—SA-51** (multilithographed; available to April 1, 1958).

THE determination of moment of inertia of physical objects is a problem which occurs frequently in the field of machine design. In early stages of design, calculated values are used of necessity. Formulas for a large number of geometrical bodies have been worked out and are available in the literature. Often, however, the complexity of a particular object or part may be such that it is impractical, if not impossible, to compute its moment of inertia by analytical means, in such cases, experimental methods are of great help in obtaining solutions. Even where analytical values have been computed, it is good practice to confirm these values by experiment as soon as parts are fabricated.

The usual experimental method makes use of the fact that the moment of inertia of any physical object with respect to a specified axis is a function of the period of oscillation of the object when it is suspended as a pendulum and allowed to oscillate freely about that axis. In the design of reciprocating engines, for example, the moment of inertia of each connecting rod may be found by timing the period of oscillation when it is allowed to swing freely about one end, as a compound pendulum. As another example, the torsion pendulum principle may also be used to find the moment of inertia of a body.

A trifilar pendulum consisting of a platform suspended by three wires may be used to determine the moment of inertia of an object by measuring the period of oscillation of the platform when the object is placed upon it. This paper describes the pendulum and derives the equation for the vibrating system. The accuracies which are obtainable are discussed, together with various features of operation, including an electric timer which has been developed for use with the pendulum.

The trifilar pendulum offers several advantages. It makes use of only one basic piece of equipment to test objects with a wide variety of shapes and sizes. The three-wire suspension possesses inherent stability, enabling the test specimen to be placed off-center if it is desired to find the moment of inertia about an axis not passing through the center of gravity of the specimen. The device is portable, allowing it to be moved to the most convenient location for testing.



Trifilar pendulum for the determination of moment of inertia of physical objects by measuring the period of oscillation of the platform when the object is placed upon it. Typical setup, hemispherical specimen.

Applied Mechanics

Dynamic Response of Beams and Plates to Rapid Heating, by B. A. Boley and A. D. Barber, Columbia University, New York, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-17** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

THE analysis of the behavior of various types of structural elements subjected to elevated temperatures is often of paramount importance in the design of high-speed aircraft or projectiles. In order to perform a practical analysis of this kind, it is of course always necessary to make a number of simplifying assumptions; it is the purpose of this paper to examine the importance of one of these, namely, that concerned with the role of inertia.

The thermally induced vibrations of rectangular plates and beams under some typical heat applications are studied. The basic parameter of the problem, B, is found to depend on the natural frequency of the structure and on a characteristic thermal time. Curves are presented of the variation with B of the ratio of the deflections calculated including and neglecting the effect of inertia. The role of inertia is found to be important for rapidly applied heat inputs and for thin plates. An approximate formula for its rapid estimation is also presented.

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Stresses in Beams During Transverse Impact, by K. E. Barnhart, Jr., Assoc. Mem. ASME, and Werner Goldsmith, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-27** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

A THEORY is developed for the transverse impact of spheres on elastic beams which incorporates a dynamic plastic force-indentation law and linear elastic boundary conditions. A method is devised to account for the effect of an infinite number of bending modes. The influence of various force-indentation relations on the calculated stress history is discussed and a comparison with an experimental stress curve is provided.

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Buckling of Thin Cylindrical Shell Under Hoop Stresses Varying in Axial Direction, by N. J. Hoff, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1957 Applied Mechanics Summer Conference paper No. **57—APM-20** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

NONUNIFORM hoop compression can arise in a thin circular cylindrical shell when it is so heated that its temperature varies in the axial direction, or if it is heated uniformly or compressed by a uniform external pressure while the deformations of some of its sections are prevented by geometric constraints.

In this paper the buckling of a thin cylindrical shell simply supported along the perimeter of its end sections is analyzed under hoop compressive stresses varying in the axial direction. The thermal stresses arising from a uniform increase in the temperature of the cylinder are determined. It is found that such thermal stresses are not likely to cause elastic buckling. Simple approximate formulas are developed for buckling stress and thermal stress.

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Superharmonic Oscillations as Solutions to Duffing's Equation as Solved by an Electronic Differential Analyzer, by C. P. Atkinson, University of California, Berkeley, Calif. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-45** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

THIS paper presents the experimental response curves for the solutions of Duffing's equation for that frequency range where higher-order harmonics (called superharmonics as opposed to lower order or subharmonics) of the fundamental are important components of the solution. The experimental results were obtained by solving Duffing's equation on an electronic differential analyzer. The paper presents corroboration of analytical results for the third-order superharmonic component of solutions which were calculated by a two-term Ritz approximation. The results of this paper indicate that superharmonics of higher order than the third, that is, fifth and seventh order, and even-order harmonics such as second and fourth order can be found in the frequency range studied.

This paper points out a definite relationship which exists between the superharmonic generated and the free-vibration curve ("backbone") of the system. For example, if we compare the maximum displacement of the solution containing an nth order superharmonic with the same amplitude of the free-vibration curve, it is seen that the frequency of the fundamental (the forcing frequency) is $1/n$ times this natural frequency, or, conversely, the frequency of the superharmonic component is n times that of the fundamental and has in fact the frequency of the free vibration for that amplitude. Thus a superharmonic of order n can be pictured as a sustained free vibration which is generated when the frequency of the forcing function is $1/n$ of the frequency of the free-vibration response curve.

The phenomenon of superharmonic oscillations is pictured here as a nonlinear resonance. Experimental evidence of the superharmonic-jump phenomenon as discovered analytically by John Burgess also is presented in this paper.

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Cylindrical Shells Under Line Load, by R. M. Cooper, Assoc. Mem. ASME, University of Michigan, Ann Arbor, Mich. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-28** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

THE problem of a line load along a segment of a generator of a simply supported circular cylindrical shell is treated using shallow cylindrical shell equations which include the effect of transverse-shear deformation. The line load is first treated as a sinusoidally varying edge load over the length of the shell, with boundary conditions prescribed along the loaded generator such that the continuity of the shell is maintained. The solution for the problem of a uniform line load over a segment of a generator is obtained from the preceding solution, using the principle of superposition. By means of a numerical example it is shown that the results predicted by the Donnell equations for the stresses are in excellent agreement with those obtained from the system of equations employed here. However, the radial displacement predicted by the Donnell equations is in error by as much as 20 per cent in the range of shell geometry considered.

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Behavior of Cylinders With Initial Shell Deflection, by M. E. Lunchick and R. D. Short, Jr., David Taylor Model Basin, Washington, D. C. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-35** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

EVIDENCE is presented which indicates that, for stiffened cylinders fabricated by welding, initial deflections exist for the shell between frames. The initial deflections of the shell of a stiffened cylinder were measured and found to be approximated closely by a second-degree curve. Using the mathematical expression for the initial deflection curve, a theoretical analysis was made for a cylinder subjected to external hydro-

static pressure, resulting in expressions for the additional deflections and stresses caused by the initial deflection of the shell. Since the initial deflections of the shell for internally and externally framed cylinders were found to be of opposite sign, the theory is offered as a possible explanation of the observed differences in behavior between internally and externally framed cylinders.

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The Effect of Lubricant Inertia in Journal-Bearing Lubrication, by J. F. Osterle, Assoc. Mem. ASME, Y. T. Chou, and E. A. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-37** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

IN MOST hydrodynamic bearings the lubricant flow is laminar and as such is governed by a differential equation which relates the pressure and viscous forces acting on a particle of the lubricant to the lubricant inertia in accordance with Newton's second law of motion. The importance of the inertia term (relative to the viscous term) in this equation can be characterized by a Reynolds number which increases as the inertia effect increases. In the operation of most present-day bearings the Reynolds numbers are small enough so that the inertia effect can be ignored safely, reducing the governing relationship to the familiar Reynolds equation.

The Reynolds equation of hydrodynamic theory, modified to take lubricant inertia into approximate account, is applied to the steady-state operation of journal bearings to determine the effect of lubricant inertia on the pressure developed in the lubricant. A simple relationship results, relating this "inertial" pressure to the Reynolds number of the flow. It is found that the inertia effect can be significant in the laminar regime.

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A Method for Solving Problems of Irrotational Gas Flow by Means of High-Speed Digital Computers, by Toyoki Koga, California Institute of Technology, Pasadena, Calif. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-43** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

A NUMERICAL procedure is proposed for solution of certain problems in steady gas flow where subsonic, sonic, and supersonic regions appear simultaneously. The difficulties that occur in analytical methods for taking into account the differences of the type of the fundamental equation (elliptic, parabolic, hyperbolic) are avoided. Given a streamline and the state of the gas along that streamline, the co-ordinates of the neighboring streamline and the state of gas along it can be computed. The procedure can be applied successively to cover a flow field. The method is described in detail for two-dimensional, steady, irrotational flow (without shocks) of a perfect gas, and an example is given.

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Turbulence in Small Air Jets at Exit Velocities Up to 705 Feet per Second, by L. W. Lassiter, Lockheed Aircraft Corporation, Marietta, Ga. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-34** (in type; published in the *Journal of Applied Mechanics,* September, 1957; available to April 1, 1958).

TURBULENCE intensity, scale, and spectrum measurements were made on model jets of 1 in. and 2 in. diam at various mean velocities. The indications are that only in the fully developed flow is turbulence intensity invariant with mean velocity; intensity in the core, in the turbulent annulus, and in the transition region decreases in varying degrees with mean velocity increase. Longitudinal and radial scales of turbulence were found to increase in the annulus in proportion to about the square root of axial distance, and longitudinal scale is about 65 per cent greater than radial scale. Both radial and longitudinal scales seem to be essentially constant with mean velocity. Turbulence spectra were found to consist of a sharply peaked band of frequencies in the core, degenerating to a slightly peaked broad band at points in the mixing regions.

●

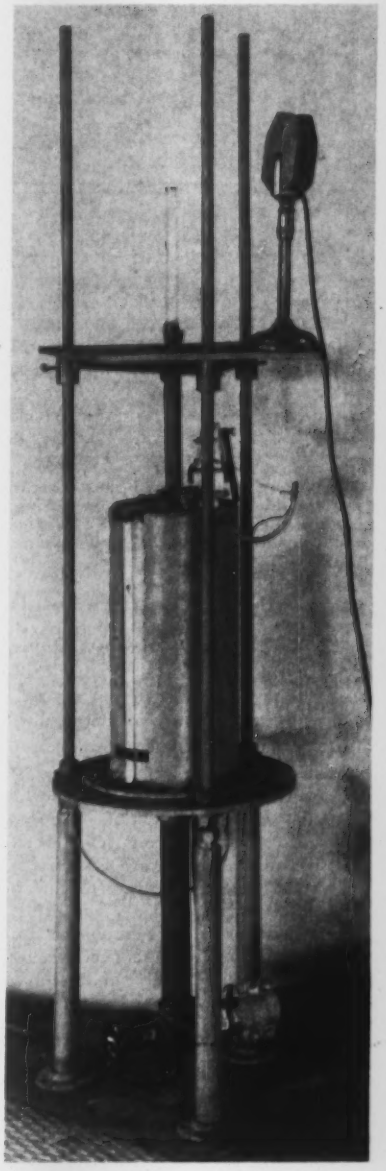
A Type of Flame-Excited Oscillation in a Tube, by J. J. Bailey, Shell Development Company, Houston, Texas. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-26** (in type; published in the *Journal of Applied Mechanics,* September, 1957; available to April 1, 1958).

RECENT developments in aircraft and missile propulsion systems have demanded considerable research in the fields of flame stability and thermoacoustic oscillation.

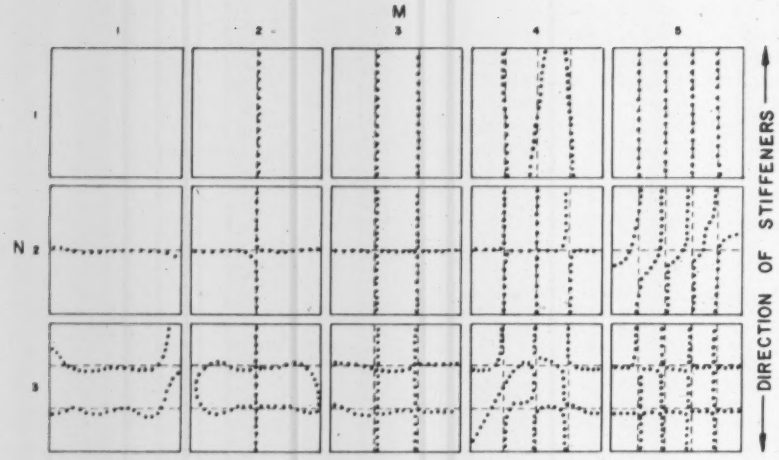
Two apparently new types of flame-excited oscillation were observed when propane-air mixtures were burned in an effectively open-ended tube containing a screen flameholder. In these tests flame-excited oscillations were observed with cellular flames and with flat flames. The latter is described in this paper in detail.

A driving mechanism depending on varying flame speed is proposed for the case of the flat flame, and a simple analysis of the driving and damping effects is made. This driving mechanism is examined in the light of Rayleigh's criterion.

A linear, one-dimensional theory is presented which takes into account the driving and damping effects in the system. The resulting theory compares favorably with experimental facts.



Apparatus for the study of flame-excited oscillations. Working section consists of a Vycor tube containing a flameholder. The flame is held on a brass screen which covers the cross section of the flameholder.



Nodal patterns for stiffened plate determined by theory and by experiments. Theoretical nodal lines are shown as dashed lines and the experimentally determined nodal lines are shown as dots. The values of *m* give the number of half waves in one direction, and the values of *n* give the number of half waves in the orthogonal direction.

The Specific Damping Energy of Fixed-Fixed Beam Specimens, by W. C. Hagel and J. W. Clark, General Electric Company, Schenectady, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-18** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

THE internal-damping effects of varying composition, heat-treatment, cold work, magnetic-field strength, stress history, and static tension stress have been studied at room temperature using fixed-fixed beam specimens supported in a new bending vibration-decay apparatus. Experimental logarithmic decrements are converted to specific damping energies by a straightforward numerical method; such information is needed to extend a fundamental understanding of the physical nature of damping and to provide useful engineering-design data. Changing hardness from 225 to 388 Bhn was found to cause a wider variation in AISI 403 specimen damping than the application of a static tension stress or d-c magnetic field. Even at relatively low vibration stresses, considerable energy dissipation originates from microscopic plastic flow in soft materials.

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On the Plane Plastic Flow of an Inset Block, by E. W. Ross, Jr., Watertown Arsenal Laboratory, Watertown, Mass. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-33** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

THE yield-point pressure is found for the plane-flow problem of a rectangular metal block, set into a rough entrenchment and squashed from above by a flat, smooth die. The block is assumed to be made of nonhardening, elastic-plastic material obeying the Mises yield condition and flow rules. The pressure is a function of both block width and depth, and for the large ratios of width/depth approaches the linear pressure variation associated with the Prandtl (cycloidal) stress distributions.

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A Donnell Type Theory for Asymmetrical Bending and Buckling of Thin Conical Shells, by Paul Seide, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-42** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

EQUATIONS are derived for bending and buckling of thin circular conical shells under arbitrary loading. These equations reduce to Donnell's equations for thin cylindrical shells when the cone semivertex angle becomes very small and the minimum radius of curvature of the median surface approaches a constant value. At the other end of the scale the equations reduce to the well-known equations for flat circular plates when the cone semivertex angle approaches a right angle. In addition, for the entire range of cone semivertex angles the equations reduce to the known equations for axisymmetrical bending when variations of the displacements around the circumference vanish. The problem of bending is reduced to the solution of a single fourth-order partial differential equation with variable coefficients.

Nodal Patterns of the Free Flexural Vibrations of Stiffened Plates, by W. H. Hoppmann, II, Mem. ASME, and L. S. Magness, Assoc. Mem. ASME, The Johns Hopkins University, Baltimore, Md. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-38** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

WITH the aid of results from previous research on the vibration of stiffened plates, a study is made of the nodal patterns of a particular plate with orthogonally placed stiffeners. The pertinent theory of vibration of stiffened plates is introduced. Experiments are described. The normal modes of vibration are investigated. Frequencies of flexural vibration are given for theory and experiment. The compounding of modes is illustrated by a single but rather convincing example. The role of research concerning normal modes of vibration of stiffened plates is discussed.

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The Creep of Thick Tubes Under Internal Pressure, by C. D. Weir, University of Glasgow, Glasgow, Scotland. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-32** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

USING the usually accepted assumption that the strain rate of a material undergoing creep is given by the product of the stress deviator and a function of the shear-strain energy, and assuming constant density, equations are derived for the creep stresses in a thick-walled tube under internal pressure for a generalized form of the shear strain-energy function. It is shown that these reduce to previously published equations on the substitution of a power law stress-strain rate equation. The nonisothermal case is considered also and creep-stress equations are obtained in a similarly generalized form.

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Calendering of a Viscoelastic Material, by P. R. Paslay, General Electric Company, Schenectady, N. Y. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-1** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

CALENDERING is the term applied to the process of rolling bulk plastic into sheets. The solution of the calendering problem for viscous materials is extended to include the first effects of elasticity. A numerical procedure for the solution of the approximate equations is contained in the Appendix.

Photothermoelasticity: An Exploratory Study, by George Gerard, Mem. ASME, New York University, New York, N. Y., and A. C. Gilbert, Mem. ASME, North American Aviation, Inc., Downey, Calif. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-25** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

THIS paper summarizes the optical and physical properties of the photoelastic model material Paraplex P-43 over the temperature range from room temperature to −40 F. Descriptions are presented of techniques and equipment developed to obtain the modulus of elasticity, the material fringe value, and the thermal-expansion coefficient as a function of temperature. Experimental investigations were conducted into the plane-stress problems of a disk contracting upon an elastic inclusion and the transient thermal-stress field produced by a temperature differential suddenly applied to the upper edge of a long beam. The data are correlated with theory using the material properties obtained in the calibration phase. Also included are photographic results of an exploratory investigation of the thermal-shock phenomenon produced by the sudden application of a temperature differential upon plastic beams of various length-depth ratios.

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Analysis of Stresses and Strains Near the End of a Crack Traversing a Plate, by G. R. Irwin, U. S. Naval Research Laboratory, Washington, D. C. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-22** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

A SUBSTANTIAL fraction of the mysteries associated with crack extension might be eliminated if the description of fracture experiments could include some reasonable estimate of the stress conditions near the leading edge of a crack particularly at points of onset of rapid fracture and at points of fracture arrest. It is pointed out that for somewhat brittle tensile fractures in situations such that a generalized plane-stress or a plane-strain analysis is appropriate, the influence of the test configuration, loads, and crack length upon the stresses near an end of the crack may be expressed in terms of two parameters. One of these is an adjustable uniform stress parallel to the direction of a crack extension. It is shown that the other parameter, called the stress-intensity factor, is proportional to the square root of the force tending to cause crack extension. Both factors have a clear interpretation and field of usefulness in investigations of brittle-fracture mechanics.

Forced Vibrations of Systems With Nonlinear, Nonsymmetrical Characteristics, by S. Mahalingam, University of Ceylon, Colombo, Ceylon. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-3** (in type; published in the *Journal of Applied Mechanics*, September, 1957; available to April 1, 1958).

MANY approximate methods have been suggested for determining the forced vibration of single-degree-of-freedom systems with nonlinear elasticity and, while short methods are availabe for solving special problems, the most general methods involve a great deal of numerical computation. The comparative accuracies of the methods available appear to vary with the problems and the way in which they are considered.

A one-term approximate solution is given for the amplitudes of steady forced vibration of a single-degree-of-freedom system with a nonlinear (nonsymmetrical) spring characteristic. The method is similar to that of Martienssen, but the construction uses a modified curve (or "frequency function") in place of the actual spring characteristic, the curve being so chosen that it gives the correct frequency for free vibrations. The method is extended to deal with a nonlinear vibration absorber fitted to a linear system.

Nuclear Engineering

On the Design of a Liquid-Metal-Heated Bayonet-Tube Steam Generator, by Frank Boni, Assoc. Mem. ASME, Griscom-Russell Company, Massillon, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-24** (multilithographed; available to April 1, 1958).

CONFIGURATIONS of heat exchangers of various types for liquid metal to water and/or steam service have been designed, fabricated, and tested in recent years. These heat exchangers are commonly designated steam generators.

The steam generator under discussion in this paper includes an evaporator, superheater, and a steam drum. The steam drum may be a single unit or combined in a single vessel with the evaporator. Discussion is limited to the evaporator and superheater.

Operating experience has indicated structural deficiencies in some equipment of this nature. Fleischman and Koenig have attributed these deficiencies to faulty material, corrosion, overstressing, and inadequate structural detail.

It has been determined that structural fracture or damage occurs more frequently in the vicinity of the tube-to-tube sheet attachment than in any other region.

In an effort to overcome these weaknesses and to provide other improvements, a study group was assembled and basic design objectives were established. The study group consisted of certain manufacturers in the boiler and heat-exchanger industry as well as a customer who had operational experience with liquid-metal-heated steam generators. The author's company proposed a bayonet-type steam generator. This configuration had certain features which would better accommodate the unique problems presented by the use of alkali metals as heating media in the generation and superheating of steam.

It is recognized that in such a steam generator the heat transfer, fluid flow, and structural design are closely interrelated; however, only the latter is considered in detail.

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Design and Testing of Containment Provisions for the Engineering Test Reactor, by A. L. Lindsay, P. D. Bush, J. Finke, R. W. Zeiser, E. A. Dukleth, J. P. Ernst, Assoc. Mem. ASME, and A. T. Chute, Kaiser Engineers, Inc., Oakland, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-23** (multilithographed; available to April 1, 1958).

THE Engineering Test Reactor (ETR), is located at the National Reactor Testing Station in Idaho. ETR has been constructed for the purpose of testing materials, fuel elements, fuel assemblies, and other reactor components at very high thermal and fast neutron fluxes, and under temperature and pressure conditions approaching those expected in their proposed applications.

The engineering development and design of the containment provisions required for this reactor are described in this paper. When making containment provisions it is necessary to consider what is to be contained, and why it must be contained. The type of reactor and coolant, the temperature and pressure of the coolant, and the kind of experimental auxiliaries, determine what is to be contained. The amount and type of radioactivity that might be released if an accident occurs and the proximity of the reactor to populated areas or vital facilities determine why it must be contained.

The topics discussed are the reactor building and its ventilation system, the entire primary coolant loop and radioactive waste disposal, together with alternate arrangements and comparisons of cost. The methods selected for testing the containment provisions in the reactor building and the primary coolant loop are discussed.

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Management

Personality Factors in Engineering Practice, by F. L. Ryder, Republic Aviation Corporation, Farmingdale, N. Y. 1957 ASME Semi-Annual Meeting paper No. 57—SA-42 (multilithographed; available to April 1, 1958).

PERSONALITY traits which commonly affect the practical performance of engineering work are discussed in this paper. The qualities of thoroughness, explicitness, technical-mindedness, practical judgment, open-mindedness, and sensitivity to criticism are outlined. An understanding of these traits is useful in the initial selection of engineers, on-the-job evaluation, and in the distribution of assignments.

Most engineers continually, and often unconsciously, form judgments of their colleagues based on their own experience, intelligence, personality, and so on. These judgments can be improved by an appreciation of the complexity of the human personality and of its importance, not only in the interrelationships of people but also in the nature of their work and output. The concept of the complex personality, and of the great variation from one individual to another, may be hard to take for those who think of the "normal" man as a standardized prototype.

ASME Transactions

THE September, 1957, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following:

Technical Papers

Unsteady Flow of Gas Through a Semi-Infinite Porous Medium, by R. E. Kidder. (57—APM-13)

A Type of Flame-Excited Oscillation in a Tube, by J. J. Bailey. (57—APM-26)

A Photoelastic Study of Strain Waves Caused by Cavitation, by G. W. Sutton. (57—APM-15)

Turbulence in Small Air Jets, by L. W. Lassiter. (57—APM-34)

Photothermoelasticity: An Exploratory Study, by George Gerard and A. C. Gilbert. (57—APM-25)

Analysis of Stresses and Strains Near End of a Crack, by G. R. Irwin. (57—APM-22)

Stresses in a Perforated Strip, by Chih-Bing Ling. (57—APM-8)

Axisymmetric Thermal Stresses in Spherical Shell, by E. L. McDowell and E. Sternberg. (57—APM-14)

Saint Venant's Principle: A Biharmonic Eigenvalue Problem, by G. Horvay. (57—APM-21)

Direct Method for Determining Airy Stress Functions, by Ching-Yuan Neou. (57—APM-2)

Finite Twisting and Bending of Thin Plates, by Eric Reissner. (57—APM-23)

Deformation of Elastic Paraboloidal Shells of Revolution, by C. N. De Silva. (57—APM-5)

Buckling of Thin Cylindrical Shell Under Hoop Stresses, by N. J. Hoff. (57—APM-20)

Dynamic Response of Beams and Plates to Rapid Heating, by B. A. Boley and A. D. Barber. (57—APM-17)

Motion and Stress of an Elastic Cable Due to Impact, by F. O. Ringleb. (57—APM-10)

Specific Damping Energy of Fixed-Fixed Beam Specimens, by W. C. Hagel and J. W. Clark. (57—APM-18)

Study of Propagation of Flexural Waves, by E. A. Ripperger and H. N. Abramson. (57—APM-11)

Forced Vibration of Systems with Nonlinear Characteristics, by S. Mahalingam. (57—APM-3)

Stresses in Beams During Transverse Impact, by K. E. Barnhart, Jr., and W. Goldsmith. (57—APM-27)

Displacements in a Wide Curved Bar, by B. W. Shaffer and R. N. House, Jr. (57—APM-24)

Interaction Curves for Shear and Bending of Plastic Beams, by P. G. Hodge, Jr. (57—APM-19)

Plane Plastic Flow of an Inset Block, by E. W. Ross, Jr. (57—APM-33)

Principle of Haar and von Karman in Plasticity Problems, by Leo Finzi. (57—APM-6)

Creep of Thick Tubes Under Internal Pressure, by C. D. Weir. (57—APM-32)

Design Data and Methods

Thermal Stress and Deformation, by J. N. Goodier

Brief Notes

Mobility of Levers Having Uniformly Distributed Mass, by M. D. Creech

Torsion of Circular Shafts of Variable Diameter, by P. P. Chattarji

Analysis of Stress Distributions by Superposition, by G. A. Zizicas

Discussion

On previously published papers by William Prager; H. H. Korst; R. F. Steidel, Jr.; Walter Freiberger; Brahmadev Sharma; D. S. Johnson; and M. M. Abbassi

Book Reviews

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Technical Ghostwriting

Comment by C. Norman Fletcher[1]

I AM in complete accord with the views expressed in this paper.[2] What I fail to understand is the attitude of those who wish to minimize the importance of English in school and college curriculums.

For example, repeated attempts have been made to remove English from the list of compulsory subjects for the entrance examination of the University of London, England, and apparently, similar attempts are made from time to time in the United States, too.

Even the existing standard of English writing found among engineers and scientists often serves to illustrate the fact that ideas in themselves are useless unless they can be communicated clearly to others. People deficient in English may, perhaps, become adept in the use of specialized scientific or technical terms, but can only pass on their ideas to those similarly adept in the practice of their own jargon.

As engineers and scientists well know, it is extremely difficult to make somewhat abstruse technical matters intelligible in ordinary English, especially to nontechnical people. Yet, in this scientific age it is most desirable that it should be done. Here is where the specialist in technical writing can find his most valuable métier.

Comment by Gilbert S. Bahn[3]

To me it is a curious thing that while members of the engineering profession generally stress the desirability of the well-rounded man, whenever thought is given to the engineer's place in society, so much circumscription seems to be advocated, attempted, and/or introduced within the profession itself. Now we have this paper[2] advocating technical ghostwriting. Last month we had a paper in the British journal, *Engineering*, by Moulijn, advocating documentation specialists to keep us from doing literature searches and reviews. In a place of previous employment I ran into acute troubles when I tried to engage in technical correspondence with potential vendors, by encroaching upon the domain carved out there by the purchasing agents. And so it goes.

I would say this to all and sundry: I am an engineer. I am competent to do my own report writing, my own literature searching, my own correspondence with vendors in search of technical information. At least, I think I am. And if I am not, I had better learn quickly, and so likewise had my colleagues, lest we become so specialized and straightjacketed that we do not qualify at all as professional men.

Author's Closure

As an engineer, I'm sure that Mr. Bahn has had a much better training in mathematics than he has had in composition. Further, I'm sure that he is perfectly capable of handling the routine mathematical chores that go with his position. But I strongly suspect that his company, when it needs a rigorous mathematical treatment of a problem, gives the job to a mathematician rather than to an engineer. I also suspect that Mr. Bahn, faced with the necessity of a complicated operation, would not refuse to see a surgeon on the grounds that his family physician should be capable of surgery. Yet the professional status of neither the general practitioner nor the surgeon is called into question.

I do not advocate, as Mr. Bahn supposes, narrow specialization. I should want my family doctor to be able to operate if the need arose for him to do so, and I should think that all surgeons should have a sound working knowledge of the prevention and cure of common diseases.

The engineer who is well trained in both mathematics and composition will be more valuable to his firm than an engineer who is not. The mathematician who is well grounded in the basic disciplines of both engineering and communication is a better mathematician than one who is not, if the level of mathematical competence is the same for both. There can be no quarrel with the ideal of the well-rounded man, but today Leonardo da Vinci would, of necessity, be a team of specialists. The effectiveness of the team would be greatly enhanced if each member were a *well-rounded* specialist. But even if this ideal were achieved, we should still need the specialists, including the writer-editor.

Nor do I advocate technical ghostwriting in the sense of trying to "sell" it. I don't need to. It's already here. I simply attempted to lay down the ethical basis for it.

I agree with Mr. Fletcher that the ability to handle language effectively should be a part of the mental equipment of every professional person. I do not, however, feel that the engineers and scientists are more deficient in this requirement than the members of other professional groups. The sad truth is that, regardless of his curriculum, today's average college graduate does not know how to communicate effectively.

This fact is no particular fault of the students. It is, rather, a natural and logical product of the type of training they receive at our colleges and universities. It will continue to exist until our institutions of higher education establish certain minimum standards for the students' written work and then make it clear to them that violation of these standards is just as serious as, for example, the violation of the basic principles of mathematics. If our colleges and universities would insist upon such standards for the students' written and spoken communications, we should soon be graduating literate professional apprentices.

Christian K. Arnold.[4]

[1] Managing Director, Edward G. Herbert, Ltd., Atlas Works, Levenshulme, Manchester, England. Mem. ASME.

[2] "Technical Ghostwriting...A Ghost's Point of View," by Christian K. Arnold, MECHANICAL ENGINEERING, vol. 79, April, 1957, pp. 348–349.

[3] Technical Co-ordinator, Combustion Research Department, Marquardt Aircraft Company, Van Nuys, Calif. Mem. ASME.

[4] Staff Assistant to the President, The Pennsylvania State University, University Park, Pa.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Foundations

FOUNDATIONS: DESIGN AND PRACTICE. By Elwyn E. Seelye. John Wiley & Sons Inc., New York, N. Y., 1956. Cloth 8 × 10 in., indexes, appendixes, tables, figs., recommendations, glossary, problems, examples, references, notes, plates, xxviii and 457 pp., $16.

Reviewed by George R. Rich[1]

THE author has prepared a cogent and synoptic crystallization of modern foundation design and practice. The treatment is terse and incisive, utilizing to the fullest extent drawings and computations, the compact language of the practicing engineer. The chapters devoted to engineering properly include complete representative computations and design drawings for pile and soil-bearing footings, retaining walls, bridge piers and abutments, sewers, culverts and conduits, earth and masonry dams, relieving platforms, sheet pile bulkheads, cofferdams, shoring, and underpinning. In the sections devoted to soil mechanics it is gratifying to find not only thoroughly practical adaptation of modern theory, but also the older concepts of dry and saturated earth pressures. The latter are valuable as a means of checking and setting practical boundaries to the results obtained by the more extended recent analyses.

There is a wealth of working details among which might be mentioned in passing as typical and timely: (1) the correct and incorrect design of fixed and expansion bearings for steel bridges and arches, (2) practical hinged joint details for reinforced-concrete rigid frames, (3) foundation details to conform with modern codes for seismic resistant structures. The sections on foundation exploration, soil-bearing tests, and borings, grouting, and foundation preparation and treatment afford condensed practical presentation of the essential considerations, not readily available in the previous texts. The designing engineer in the office particularly will welcome the liberal portion of the book devoted to practical construction equipment and procedures, the correct understanding of which is prerequisite to economical design. To complete the usefulness of the work, excellent chapters are provided on specifications and cost estimating, the later information being referenced to the ENR cost index for ready adjustment to changing market conditions.

Finally, and by no means least in importance, are the valuable comments on difficulties often encountered under the recurring caption "Red Lights." As the author so aptly remarks, "Foundation engineering is not a 'push-button' subject"; but this concise yet comprehensive text will certainly assist "the reader to become a well-rounded foundation engineer, as far as this is possible without years of office design work and field experience."

[1] Director, Chas. T. Main, Inc., Boston, Mass. Mem. ASME.

Books Received in Library

ASTM STANDARDS ON TEXTILE MATERIALS. Published 1956 by the American Society for Testing Materials, Philadelphia, Pa. 814 p., 6 × 9 in., paper. $6.25. Of the 126 standards and tentatives included in this compilation, 21 are new and 8 revised since the previous edition was published in January, 1956. The standards cover definitions and terms; testing machines; humidity testing; fibers; yarns; nonwoven fabrics; and textiles of cotton, glass, rayon, silk, and wool. A subject index is provided.

AERODYNAMIC COMPONENTS OF AIRCRAFT AT HIGH SPEEDS. Edited by A. F. Donovan and H. R. Lawrence. 1957, Princeton University Press, Princeton, N. J. 845 p., 6¼ × 9½ in., bound. $17.50. This is volume seven of the series "High Speed Aerodynamics and Jet Propulsion," a comprehensive survey of fundamentals for designers, research engineers, and advanced students. The main sections, prepared by various authorities, are devoted to the steady state aerodynamics of wings; aerodynamics of bodies at high speed; interactions between wings, body, tail, and propeller; propellers at high speed; and diffusers and nozzles. Other sections deal with nonsteady wing characteristics and the experimental aerodynamics of wings. Extensive reference lists are given after each section.

BEARING DESIGN AND APPLICATION. By D. F. Wilcock and E. R. Booser. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 464 p., 6 × 9¼ in., bound. $12.50. In this practical guide for the machine designer, the bearing is considered from three aspects: the design, including its geometry and tolerances; the materials from which it is made; the lubricant used to minimize wear and tear in its operation. The book is divided into two main parts on rolling bearings and sliding bearings. Useful features are trouble shooting chapters for both types of bearings and a discussion of the selection of bearing class. Much of the material has been provided by the authors' consulting practices during the past ten years.

ELEMENTS OF GASDYNAMICS. (GALCIT Aeronautical Series.) By H. W. Liepmann and A. Roshko. 1957, John Wiley and Sons, Inc., New York, N. Y. 439 p., 6 × 9¼ in., bound. $11. Stressing fundamental theory, this book deals with waves in supersonic flow; flow in ducts and wind tunnels; small-perturbation theory; transonic flow; and other topics of interest to engineers who work on problems involving the aerodynamics of compressible fluids. The book has been written as a text for senior and graduate courses and as an introduction to the more specialized studies for practicing engineers.

ENGINEERING AND TECHNICAL HANDBOOK. By D. C. McNeese and A. L. Hoag. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 376 p., 4⅞ × 7⅞ in., bound. $6. This concise handbook is divided in five parts: basic formulas and fundamentals which may be applied to both engineering and physics; general information such as atomic weights and constants of the elements, strength of materials, coefficients of friction, and kinetic viscosity of various fluids; an alphabetical listing of units with their equivalents; mathematical computations ranging from arithmetic to integral calculus with illustrative examples; and the mathematical tables generally used in engineering and allied fields.

ESSENTIAL FACTORS IN THE FUTURE DEVELOPMENT OF THE PETROLEUM INDUSTRY. Edited by George Sell. 1956, Institute of Petroleum, London, England. 176 p., 5½ × 8¼ in., bound. £2. This volume consists of the papers, with discussion, that were presented at the 1956 summer meeting of the Institute of Petroleum. The subjects of the papers are as follows: World energy demand and the prospects for solid, liquid, and gaseous fuels and hydroelectricity; the economics and application of atomic energy; probable oil demand; oil resources; methods of transport; refining techniques; oil as a source of chemicals; and financial aspects of oil-industry developments.

HIGHWAY RESEARCH BOARD PROCEEDINGS. Thirty-Fifth Annual Meeting, January, 1956. Edited by F. Burggraf and E. M. Ward. 1956, National Research Council, Washington, D. C. 840 p., 6½ × 9¾ in., bound. Price not given. The more than 50 papers in these proceedings are grouped by the various departments of the Board: Economics, Finance, and Administration; Design; Materials and Construction; Maintenance; Traffic and Operations; and Soils, Geology, and Foundations. A wide

range of topics in these areas is discussed in the individual papers—financial planning, design of semiflexible pavements, the strength of bituminous mixtures, bridge maintenance, television in traffic control, vibratory cutting of soils, etc.

A History of Technology. Vol. 2, The Mediterranean Civilizations and the Middle Ages. Edited by Charles Singer and others. 1956, Oxford University Press, New York, N. Y. 802 p., $7^1/_4 \times 10$ in., bound. $26.90. This is the second volume of a series of five which will cover the development of technology from the Old Stone Age to the later 19th century. The first volume, already published, was from early times to the fall of ancient empires c. 500 B.C. The present one covers the Mediterranean civilizations and the Middle Ages. Only the technology of Europe is dealt with, and the concern is mainly with the development of processes, techniques, and devices rather than with social and economic implications. The range of subjects includes all those activities which provide for material needs: mining, quarrying, metallurgy, agriculture, leather, textiles, ceramics, glass, building construction, transportation, metal work, machinery, power, hydraulic engineering and sanitation. Six hundred ninety-five illustrations including maps and diagrams and an additional 44 plates are provided. Literature sources are found at the end of each chapter, and personal and place name indexes are appended.

International Association for Bridge and Structural Engineering. Publications, Vol. 16, 1956. Verlag Leemann, Zürich, Switzerland. 550 p., $6^5/_8 \times 9^3/_8$ in., paper. Price not given. Twenty-eight papers, 16 in English, 6 in French, and 6 in German, with titles and summaries given in the three languages. Some examples of the topics covered in the papers are analyses of thin-walled continuous shells; scale model investigation of shell roofs; a method for calculating circular cylindrical shells; the plastic design of aluminum structures; vibrations in steel and reinforced concrete bridges; impact accompanied by fatigue; and assembly of prefabricated reinforced concrete components for hangars.

Regelung von Dampf- und Gasturbinen. By I. I. Kirillow. Translated from the Russian. 1956, VEB Verlag Technik, Berlin, Germany. 395 p., $6^1/_2 \times 9^1/_2$ in., bound. DM 30.00. The first two sections of this text on the regulation of turbines deal with the statics and dynamics of mechanical regulatory action. The latter half considers the various mechanical and hydraulic control devices and their operation under two headings: regulation of steam turbines; regulation of gas turbines. A considerable amount of mathematical analysis is included in this translation into German of a current Russian work.

Relaxation Methods in Theoretical Physics, Vol. 2. By R. V. Southwell. 1956, Oxford University Press, New York, N. Y. 522 p., $6 \times 9^1/_2$ in., bound. $8.80. This second volume of the two-volume set discusses equations of higher order than the second, equations involving three independent variables and equations which are nonlinear. Some of the problems in the book, originally started in 1946, have been reworked, in several cases resulting in the improvement of technique. For eigenvalue problems in particular, better methods of solution have been evolved quite recently. The subject fields investigated include mechanical and electrodynamic systems, hydrodynamics, elasticity and plasticity, and membrane theory.

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Scientific Uses of Earth Satellites. Edited by James A. Van Allen. 1956, University of Michigan Press, Ann Arbor, Mich. 316 p., $6^3/_4 \times 10^1/_4$ in., bound. $10. This compilation of 33 papers represents current thought on the utilization of artificial satellites for scientific purposes. Among the subjects dealt with are the optical and visual tracking of a satellite; satellite instrumentation; meteorological observations from a satellite; cosmic ray observations; measurements of the earth's magnetic field; plotting out of the auroral zone; studies of ionospheric structure, and detection of meteoric particles. All the papers were presented at the tenth anniversary meeting of the Upper Atmosphere Research Panel, in January, 1956.

Spannungserhöhung am Rande von Löchern. By G. N. Sawin. 1956, VEB Verlag Technik, Berlin, Germany. 448 p., $6^3/_4 \times 9^1/_2$ in., bound. DM 45.00. A translation into German of a Russian treatise giving a detailed analysis of stress concentration around holes in plates. The first chapter discusses the fundamental equations of the two-dimensional theory of elasticity; the subsequent seven chapters deal respectively with more or less special cases such as the effect of anisotropy of the materials, hole reinforcement, bending of plates, etc. Tables and diagrams are provided for use by the engineer whose theoretical knowledge is slight.

Technical Aspects of Sound. Vol. 2. Ultrasonic Range, Underwater Acoustics. By E. G. Richardson. 1957, Elsevier Publishing Company. Available in the U. S. from D. Van Nostrand Company, Inc., Princeton, N. J. 412 p., $6 \times 9^1/_4$ in., bound. $11. A comprehensive treatment by experts of the several branches of acoustic science, of which the previous volume dealt with the sonic range and mainly with airborne sound. The present volume, in three divisions, covers ultrasonic transducers and applications, underwater acoustics, and aircraft noise, with a special chapter on underwater propulsion noise. Before each division there is a discussion of the fundamentals of the subject, and there is an extensive bibliography for each section of the division. The emphasis on applications points up its practical value as well as its use as a text.

Theory of Land Locomotion. (The Mechanics of Vehicle Mobility.) By M. G. Bekker. 1956, The University of Michigan Press, Ann Arbor, Mich. 520 p., $6 \times 9^1/_4$ in., bound. $12.50. A comprehensive compilation of the information now available on the relationships between an operating motor vehicle and its physical medium, particularly in off-the-road locomotion. The subjects covered include locomotion in nature and on wheels, problems of soil and snow mechanics, track-laying vehicles, ski and toboggan equipment, motor vehicle mechanics, trafficability of soils, and dimensional analysis. A bibliography of some 350 references is included.

Wood Structural Design Data, Vol. 1. Third Edition, 1956. Published by the National Lumber Manufacturers Association, Washington, D. C. 362 p., $8^1/_2 \times 11$ in., spiral binding. This new edition includes significant developments in the field which have occurred since the publication of the second edition in 1939. Among these are the timber-connector system of wood construction, structural glued-laminated lumber, simplified methods of column design, and more specific information on the relation of load duration to allowable stresses. Since this is intended as a practical reference aid for wood-structural design, the data are presented for the most part in tabular form. There is a subject bibliography at the end.

ASME Boiler and Pressure Vessel Code

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations

were formulated at the Committee meeting, June 28, 1957, and approved by the Board on Sept. 2, 1957.)

Case No. 1205-2 *Special Ruling*

Inquiry: Under what conditions may the carbon and alloy steel forgings of ASTM Specification A 372-53T be used in the construction of special integrally forged unfired pressure vessels and be stamped with the Code symbol? May working stresses of one third of the minimum specified tensile strength be used for storage vessels in non-corrosive service?

Reply: It is the opinion of the Committee that forgings complying with ASTM Specification A 372-53T may be used in the construction of seamless unfired pressure vessels under the rules of Section VIII provided the following additional requirements are met, and when so constructed the vessels may be stamped with the Code symbol.

(1) The maximum inside diameter of the shell is 24 in.

(2) The design temperature of the vessel is between −20 F and 650 F. (See Par. (7) (a) below for the temperature limitation on vessels built with maximum allowable working stresses of one-third the specified minimum tensile strength.)

(3) The streamlined design as shown in the sketch incorporates:

(a) No stress raisers such as welded attachments, or stamping on the shell portion.

(b) Integral heads, hot formed, concave to the pressure, and so shaped and thickened as to provide details of design and construction of the center openings which will be as safe as those provided by the rules of the Code; center openings not exceeding 50 per cent of the diameter of the vessel or 3 in. pipe size; other openings in the head not exceeding $^3/_4$ in. pipe size; openings shall be placed at a point where the calculated stress, without holes, is not more than one eighth of the specified minimum tensile strength.

(c) Only threaded openings in the shell portion not exceeding 2 in. pipe size and complying with the requirements of Par. UG-43(f). All openings shall be reinforced to satisfy the requirements of Par. UG-37. The provisions of Par. UG-36(c)(3)(b) shall not apply.

(d) No welding.

(4) The completed vessel, after all forming operations, is heat-treated by one of the applicable methods outlined in A 372. When oil quenched and tempered, forgings shall be subjected to a magnetic-particle inspection as outlined in ASTM A 275, to detect the presence of quenching cracks on the outside surface of the shell portion. A crack which is not removed within the minimum thickness of the shell is cause for rejection.

(5) The tensile properties are determined by the testing method outlined in ASTM A 372-53T using specimens which are representative of each lot and which are selected after the final heat treatment of the lot.

(6) Each vessel that is subjected to a heat-treatment involving an oil quench and temper shall be hardness-tested at 5-ft intervals with a minimum of three different locations representing approximately the center and each end of the heat-treated shell. The average of individual hardness readings at each location shall not be less than 225 Brinell nor more than 300 Brinell, and the highest average hardness shall not exceed the lowest average hardness on an individual vessel by more than 40 Brinell number. (Other hardness-testing methods may be used and converted to Brinell, using the tables in ASTM E 48.) Reheat-treatment is permitted.

(7) Maximum allowable working stresses shall be one-fourth the specified minimum tensile strength given in ASTM A 372-53T except that maximum allowable working stresses of one-third the specified minimum tensile strength may be used under the following limitations:

(a) The design temperature is between −20 F and 150 F.

(b) The vessel has no stress raisers such as openings, welded attachments, or stamping on the shell portion.

(c) The vessel is not subject to corrosion on the interior or exterior.

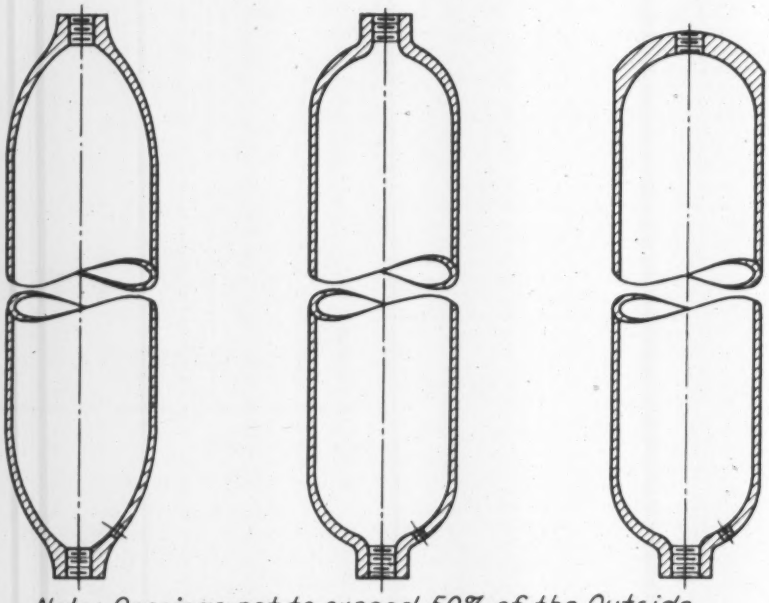
(d) The vessel is not subject to shock or rapid cyclic operation.

(e) Each vessel, regardless of heat-treatment, is subjected to a magnetic particle inspection as outlined in ASTM A 275 to detect the presence of quenching cracks on the outside surface of the shell portion. A crack which is not removed within the minimum thickness limit of the shell is cause for rejection.

(f) The vessel is stamped on the thickened head portion with both the maximum allowable working pressure based on a stress equal to one-fourth the specified minimum tensile strength and also the maximum allowable working pressure based on a stress equal to one-third the specified minimum tensile strength. The marking, "Case No. 1205," shall be stamped following the latter pressure marking.

Case No. 1240

Inquiry: May integrally finned tubes be used in the construction of unfired pres-



Sketch for Case 1205-2

sure vessels under the rules of Section VIII of the Code?

Reply: It is the opinion of the Committee that integrally finned tubes may be used in the construction of unfired pressure vessels under the rules of Section VIII of the Code provided the following requirements are complied with:

(1) The finned tubes shall be made from tubes that in every respect comply with a specification which has been approved for use under Section VIII.

(2) The finned tubes shall be furnished in a temper or condition provided for by the governing specification; for example, if the governing specification provides for a half-hard condition, the finned tubes may be furnished in this condition.

(3) Except as permitted in Item 4, the allowable stress value shall be as shown in the applicable table in Subsection C for the tube before finning.

(4) The allowable stress value for a temper or condition different from that of the tube before finning may be used provided qualifying tensile tests demonstrate such a temper or condition is attained. The qualifying tensile tests shall be made on specimens of the finned tube from which the fins have been removed by machining.

(5) The maximum allowable working pressure, internal or external, of the finned section shall be based on the minimum wall thickness of this section, but shall not exceed the maximum allowable working pressure for the unfinned portions of the tube.

(6) Each tube shall withstand, without evidence of leakage, an internal air pressure of 250 psi minimum for 5 seconds while the finned tube is immersed in water or other suitable liquid. This test on the finned tube is in addition to any hydrostatic or nondestructive electric test required by the applicable specification for the tube before finning.

Case No. 1241

Inquiry: Is it permissible to use carbon steel forgings to Specification SA-105, Grade II, for construction conforming to Sections I and VIII as modified by the following requirements?

(a) *Heat-Treatment* For sections over 3 in. in thickness, the heat-treatment may consist of accelerated cooling and tempering to provide a structure comparable to that obtained in lesser thicknesses by normalizing.

(b) *Mechanical Properties* For material over $3\frac{1}{2}$ in. in thickness a deduction from the percentage of elongation in 2 in. specified of 0.5 per cent shall be allowed for each increment of $\frac{1}{2}$ in. above $3\frac{1}{2}$ in. This deduction shall not exceed 3.0 per cent.

(c) *Inspection* All surfaces shall be inspected for injurious defects by magnetic-powder or penetrant-oil methods.

Reply: In the opinion of the Committee, carbon steel forgings made to Specification SA-105, Grade II, as modified in the inquiry may be used for construction conforming to Sections I and VIII of the ASME Boiler and Pressure Vessel Code.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Announcement

Requirements for Brazing Ferrous and Nonferrous Materials, Part C of Section IX, has been recently approved by the Boiler and Pressure Vessel Committee in conjunction with Code usage and copies are available from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Low-Pressure Heating Boilers, 1956

PAR. H-14(b) Revise to read:

The minimum thickness of copper tubes installed by rolling either straight, bent or coiled, for use in water tube or fire tube boilers, shall be as follows:

In water boilers where working pressures of over 30 psi and not to exceed 160 psi may be used:

$$t = \frac{D}{30} + 0.03$$

where t = thickness of tube wall, inches
D = outside diameter of tube, inches

For steam boilers to be used at pressures not exceeding 15 psi, and water boilers where the maximum allowable working pressure does not exceed 30 psi:

$$t = \frac{D}{45} + 0.03$$

In no case shall a tube installed by rolling be thinner than No. 16 gage (Bwg).

PAR. H-14(c) Revise to read:

The minimum thickness of copper or copper alloy tubes installed by welding or brazing or with flared connections, assembled with copper or copper alloy fittings, and used solely in water tube type water boilers, shall be:

For tubing complying with SB-75 Type DLP:

$$t = \frac{D}{50} + 0.027$$

For tubing complying with SB-111, 90-10 Copper Nickel:

$$t = \frac{D}{65} + 0.030$$

PAR. H-65 Add new paragraph after the first paragraph to read as follows:

Copper tube hot water heating and hot water supply boilers built under the rules of H-14(c) shall be subjected to a hydrostatic test not less than $1\frac{1}{2}$ times the maximum allowable working pressure.

PAR. H-68(a) Add the words "or brazed" after the word "welded" in the first line.

PAR. H-82 Add a new heading after H-82—*Brazing.*

PAR. H-83 Add three new paragraphs to read as follows:

(a) Copper and copper alloy water tube type boilers may be assembled by brazing. Brazing procedures shall be qualified in accordance with the applicable rules of Section IX of the Code. Brazers and brazing operators shall be qualified in accordance with the applicable rules of Section IX of the code.

(b) Boilers shall be stamped according to the requirements of Par. H-68, or the stamping may be placed on a nonferrous plate, irremovably attached to a visible part of the boiler.

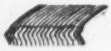
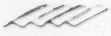
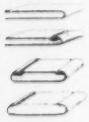
(c) Each hot water heating and hot water supply boiler shall be fitted with a relief valve or valves selected according to the requirements of H-44 and installed according to the requirements of Par. H-46 (b), H-47, H-48, and H-49.

Unfired Pressure Vessels, 1956

TABLE UA-47.1 Revise as follows:

(1) Delete entry and values for Serrated steel.

(2) Change "Grooved iron or soft steel with or without metal jacket" to "Grooved metal."

Rubber without fabric or a high percentage of asbestos fiber: Below 75 Shore Durometer		
75 or higher Shore Durometer		
Asbestos with a suitable binder for the operating conditions	1/8 thick 1/16 thick 1/32 thick	
Rubber with cotton fabric insertion		
Rubber with asbestos fabric insertion, with or without wire reinforcement	3-ply	
	2-ply	
	1-ply	
Vegetable fiber		
Spiral-wound metal, asbestos filled	Carbon Stainless or Monel	
Corrugated metal, asbestos inserted or Corrugated metal, jacketed asbestos filled		
Corrugated metal		
Flat metal jacketed asbestos filled		
Grooved metal		
Solid flat metal		
Ring joint		

(3) Substitute new drawings as given:

Table UA-47.2 Substitute lower case "*w*" in all reference to "*W*" in the sketches and formulas.

Table UA-51 Add the following definition:

w = actual Contact Width of Gasket (See Table UA-47.2).

Under the definition of "*Y*" add a lower case "*y*" before the "=" sign and the word "gasket."

Par. UG-16 Revise to read:

Plate material shall be ordered not thinner than the design thickness (see Par. UA-60(h)(2). Vessels made of plate furnished with an under-tolerance of not more than the smaller value of 0.01 in. or 6 per cent of the ordered thickness may be used at the full design pressure for the thickness ordered. If the specification to which the plate is ordered allows a greater under-tolerance, the ordered thickness of the material shall be sufficiently greater than the design thickness so that the thickness of the material furnished is not more than the smaller of 0.01 in. or 6 per cent under the design thickness.

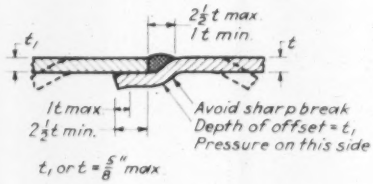
Par. UW-13 Revise as follows:

Re-letter present subparagraph UW-13(c) to read UW-13(d).

Add new subparagraph UW-13(c) as follows:

Heads concave to pressure may be attached to shells using a butt weld with one plate offset as shown in Fig. UW-13(k). The offset shall be smooth and symmetrical and shall not be machined or otherwise reduced in thickness. There shall be a uniform force fit with the mating section at the root of the weld.

Fig. UW-13(k). Delete present sketch and substitute the new sketch as given.



(k) Butt Weld with One Plate Edge Offset

Table UW-12 Rewrite as follows in limitations column for "single welded butt joint with backing strip."

(a) Longitudinal joints not over 1¼ in. thick.

(b) Circumferential joints no thickness limitation, except as in "c" below.

(c) Butt weld with one plate offset — for circumferential joints only, ⅝ in. maximum thickness per Par. UW-13(c) and Fig. UW-13(k).

Par. UCL-10 Revise to read:

The base plate and other base materials used in the construction of vessels of integrally clad plate and of those having applied corrosion linings shall comply with the requirements for materials given in Pars. UCS-5, UHA-11, or UNF-5.

Pars. UCL-23(a) and (b) Add UHA-23 or UNF-23 at the end of each paragraph.

Par. UCL-24(a) Delete "in Table UCS-23" in the last paragraph.

Par. UCL-26. In first sentence after Par. UCS-28 add UHA-28 or UNF-28; also, after Par. UCS-33 add UHA-31 or UNF-33.

Par. UCL-27 In last line, revise Pars. UCS-66 and UCS-67 to read Pars. UCS-66, UCS-67, UHA-51 or UNF-65.

Par. UCL-34(a) At the end of the first sentence delete: "By the rules in Part UCS."

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

How Timken research, engineering, and management developed and built its . . .

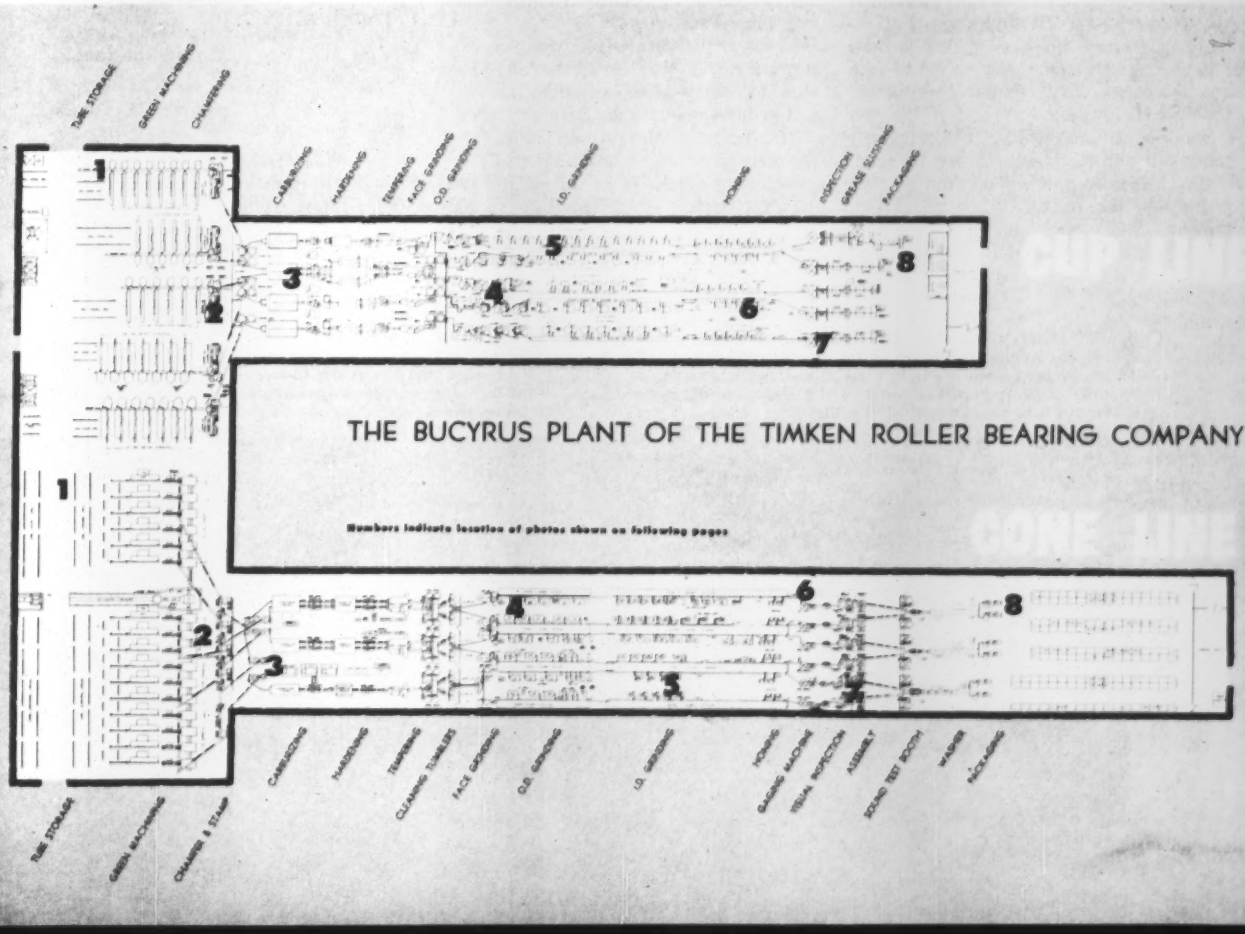
Mechanized Roller Bearing Plant

PRODUCING some 30-million roller bearings a year is quite a task, but to sell them at less cost today than in 1953 is an even greater achievement.

This has been accomplished by Timken Roller Bearing Company by complete mechanization of its Bucyrus, Ohio, roller bearing production plant. Conceived soon after World War II, and in operation for about three years, the plant was shown for the first time to members of the technical press on September 11.

There are 11 production lines in the Bucyrus plant which can turn out 34 different cup and cone sizes for the automotive industry. A total of 14 cups and cones constitute 80 per cent of the production volume. With further or increased standardization of application the production requirement could be reduced to 12 to 14 sizes. This would require fewer line changes making further economies probable.

The cup and cone lines in the Bucyrus plant are probably as automatic as anything in industry today. From the time a load of tubes is placed on the screw-machine stock rack until the finished and wrapped product is placed in the shipping box, all operations including



CUP LINE

1 Carbide tools in rapid sequence completely machine the cup on the screw machines. None of the pieces in this highly mechanized plant, except for inspection purposes, are touched by human hands. All handling is done mechanically by a system of conveyers and chutes.

2 Green machined bearing cups are transported from the screw machines to a washer, up the elevator to a storage bin, through a rotary feeder and cup turner to the marking and chamfer machines

final gaging are handled automatically. The parts move from one operation to the other by conveyer or chute.

Special Machinery

All of the screw machines and most of the other equipment had to be of special design or have special adaptations to fulfill the requirements imposed by this type of production facility. Emphasis was placed where possible on smaller machines, since the range of work performed by them was much less than their conventional counterparts. The smaller single-purpose screw machines and grinding machines made possible great savings in plant production space. Cost of each production line is about a million dollars.

Carbide tooling was one of the first developments adopted by Timken. Early in 1946 test work was started to determine what kind of a job could be done in green machining cups with carbide tools. Some machining had been done with carbide tools, but practically all products had been machined up to that time with high-speed steel tooling. This put definite limitations on possible improvements. Carbides offered seemingly limitless possibilities for increased production, but the economics of such operations were not known.

The engineering and research team soon determined that cups could be machined on single-spindle screw machines at speeds four times higher and feeds two times heavier than before. This meant that new single-spindle screw machines would produce eight times as many cups per hour as an old model single-spindle machine, and $2^1/_2$ times as many as a four-spindle automatic.

Since no such screw machine was on the market at that time, machine-tool builders, in co-operation with Timken, had to develop such a machine.

The design of the carbide tooling on the new 2-in. screw machine made it possible to save $^1/_{16}$ in. of tubing for each cup made. On the basis of present line capacity of one million cups per month, this is a saving of one mile of tubing per month.

Built-In Quality Control

The cup and cone lines have a built-in quality-control system. On critical operations, bearing parts leaving the machines are held in chutes until roving inspectors check the last piece in the chute. If the part checks within tolerance the balance in the chute is released and is conveyed to the next operation. Since elapsed time between operations is relatively short, it is quite easy to make effective changes if something is wrong. For instance, at the internal honing operation, if the ground finish is too rough and parts do not clean up in honing, a change can be made at the grinding machines to correct the condition immediately.

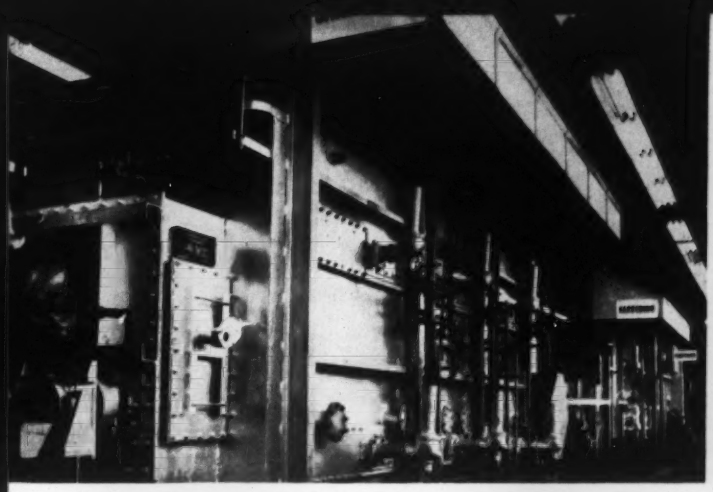
Product-Banking System

To provide a steady flow of material through all operations at predetermined average rates, a product-banking system was integrated into the production line. Each machine is integrated with and dependent upon machines preceding it

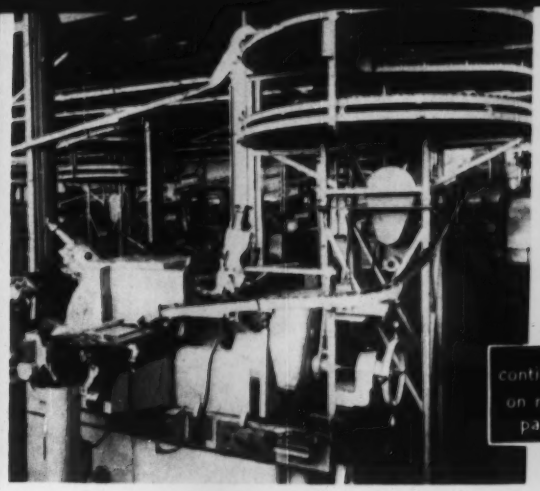
CONE LINE

1 The three-ton crane used to unload and store tubing was designed by Timken and built by Cleveland Tramrail Company. In addition to the lateral movement that permits it to span the length of the department, it can also make 360-deg turns with full bundles.

2 General view of the five cone lines in the green machining department. At *right* are the Conomatics and at *left* the presses and radius machines. The attendant in the center of the picture is checking a cone on the Kodak Contour Projector.



3 Cups and cones are processed through carburizing, hardening, and tempering furnaces during heat-treating. Even in the heat-treating departments areas are kept spotlessly clean. The new bearing plant has a production capacity of 33 million cups and 27 million cones a year.



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4 This No. 2 Cincinnati Centerless Grinder finish grinds the cups' OD to a tolerance of 0.001 in. up to 70 pieces per min depending on size of cup being run. The spiral storage rack located above the machines provides lag time between grinding operations.

in the production sequence. An interlock system provides a steady flow of product at carefully predetermined rates. No machine or group of machines, therefore, gets either too much product or too little product at one time.

Because is is economically unfeasible to start up and shut down heat-treating equipment, the heat-treating facilities are geared to handle product volume in seven days that is processed by other producing departments in five days.

To properly space product between heat-treating and the other machining operations, Timken engineers devised the product-bank system. By means of product storage or banking, a steady feed of product from one operation to another is possible. Two days' storage capacity of cups and cones between green machining and heat-treating and also between heat-treating and grinding is provided for in bulk storage bins. Smaller, bulk storage bins are located between the screw machines and stamping and chamfering operations. This banking system provides storage for product from the screw machines during periods of tool change or maintenance on these single-operation machines. Bulk storage required the development of feeding and orienting devices to put product in a single line properly positioned for the next operation.

Another vital link in the product-banking system is the distributing conveyers in the finishing departments which feed races directly into the grinding and honing machines. Bearing parts move in a continuous circle above and ahead of the machines making all parts in the reserve immediately available to all operating machines. As an opening in a machine chute occurs, a bearing part ready for processing drops into place in the chute.

The interlock system, which operates by means of a series of limit switches and photoelectric cells, stops machine operation when the machine has run out of product for processing, when the machine itself is malfunctioning, or when product is being processed too fast for a subsequent operation in the line.

Innovations and New Approaches

A number of innovations and new approaches were necessary in putting the Bucyrus plant into operation. However, there were some devices, specially designed equipment, and problem solutions that stand out. Some of these follow.

Early in the design of the screw machines the question of using hot-rolled or cold-finished tubes was carefully weighed. The advantage in using hot-rolled tubing is that the cold-finishing operation costs about $2 to $4 extra per tube depending on the size. However, the hot-rolled tubes, as rolled, may vary tube to tube by as much as 0.060 in. in OD in the larger Bucyrus sizes. Conventionally, when hot-rolled tubes are chucked in the spindle, the collet tension must be adjusted. Otherwise, a minimum-size tube might slip during the machining operation and a maximum tube might be chucked so tightly that damage to the collet or other machine parts could result.

Hand chucking of individual tubes did

3 A cross view of the center of the cone heat-treating department shows the washers and the double spiral conveyers leading to the hardening furnaces. The area under the iron latticed floor houses the oil filter and refrigerator units, and quenching tanks.

4 General view of the cone finishing department shows the small number of men needed to attend the machines on the five cone lines. A system of conveyers, chutes, and elevators connects the different machine operations. Timken invested nearly $12 million in this plant.

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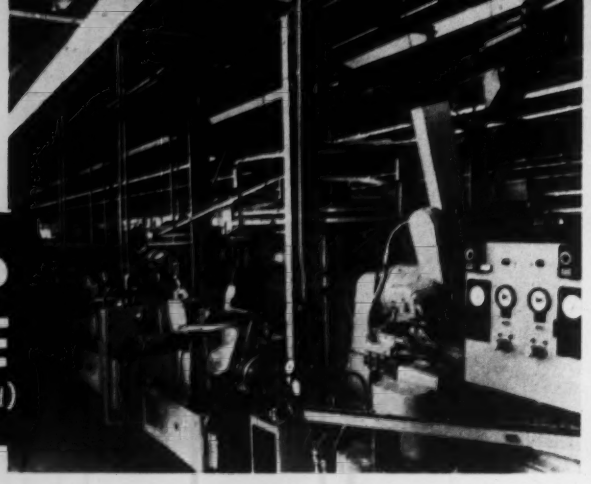
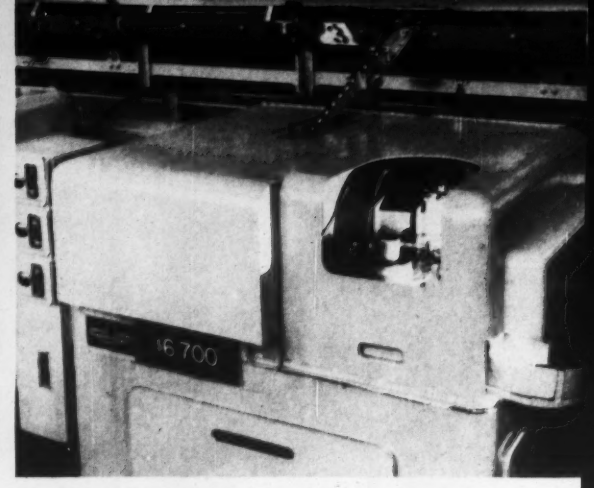
CUP LINE (continued)



5 A long shot of the number one cup line in the cup finishing department shows the straight line manufacturing process. Cups are conveyed from operation to operation by a system of conveyers, chutes, and elevators.



6 Tape honing machine finishes the critical tapered ID raceway of the bearing cup to an 8 microin. finish (0.000008). Close-up view shows honing tape reel and feed chute and feed belt.

not fit in with the Bucyrus concept of completely automatic operation. It was known that Belleville springs (dished washers) could be designed to have nearly flat load-deflection curves over a considerable range of deflection. Screw-machine suppliers fully co-operated in working out chucking devices incorporating properly proportioned Belleville springs so that in every size of machine almost constant chucking pressure over the full range of hot-rolled tube tolerances can be obtained.

It is reported that Timken is now operating the only automatic screw machines in the world that can use hot-rolled tube stock, automatically load the tubes into the machines, and start the machines under power with no hand chucking or collet adjustment—tube to tube.

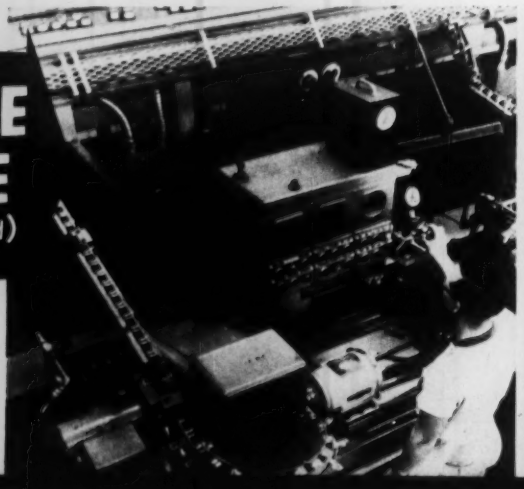
The stock racks which feed the screw machines in the green machining department are of special design. Loaded by a lift truck or crane, the stock rack holds about an eight-hour supply of tubing. Tubing is positioned in the screw machines from the stock rack automatically. When out of stock, the machine stops with loading ram retracted and the collet open. The attendant merely removes the butt end, and by simply pressing the handle of an air valve, the loading cradle is opened, a new piece of stock rolls into the cradle, the cradle closes, and a ram pushes the tubing into the spindle until it hits the stock stop. The tubing is automatically chucked and the machine resumes operation. This procedure is executed in seconds.

Provision has also been made for tool adjustment in the holders to make the tool assemblies interchangeable. The carbide tooling is preground and preset in tool holders and made ready for immediate installation on all screw machines on scheduled intervals. The advantages in presetting all cutting tools to reduce machine down time were apparent. To accomplish this, all screw machines were designed with double adjustments. In addition to the adjustments provided in the tool holders, the slides are adjustable to obtain size on a new part being set up. Thereafter, tools are changed with no further machine adjustment. By pregrinding and presetting the carbide tools, down time for tool changes is practically eliminated.

Improvement in the cutting off of tubing with carbide tools had to be worked out before single-spindle automatics could be economically operated. This was accomplished by using two cut-off tools working simultaneously, the first narrow tool cutting a single wide chip, the second, a wider tool, cutting two narrow chips. A free flow of the cut-off slit is thus possible. This tool arrangement prevents wedging of hot, expanded chips against the sides of the slot.

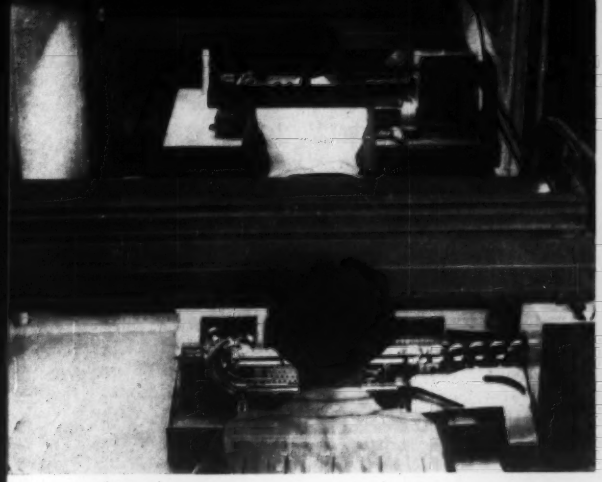
Another device designed especially for the single-spindle screw machines was a unique hydraulic system which resulted in an increase in productivity of the single spindles by as much as 30 per cent. Four slides operate off the screw machines cam shaft: the end working slide which carries boring and turning tools; forming slide which carries two radius tools; the breakdown slide carries the breakdown tool; and the cut-off slide carries the cut-off tool. All these tools work

CONE LINE (continued)



5 The Heald 190 Centrimatic grinds the ID of cones to a tolerance of 0.0005 to 0.0008 in. Cycle time ranges from 14 to 25 sec per cone. The gage mounted on the machine permits quick check of cone.

6 Long shot shows air gage inspection machine with spiral storage rack, *right*, visual inspection, *center*, and the cone assembly, *left*. Most of the shots were taken with available light since the plant is well illuminated.



7 Cups and cones are given a visual inspection prior to being washed, slushed, and wrapped. Using an artist's brush, the inspector rolls the cups down a double runway, inspecting several at a time.

8 Cups are wrapped in a waxed paper impregnated with a preservative to prevent rust of product during storage or shipping. Timken-designed wrapping machine automatically wraps cups in rolls 12 in. long.

simultaneously until just a few seconds before the cut-off tool completes the cutting cycle. Before the cut-off occurs, a separate hydraulic system makes possible the quick removal of the end working tool slide and its re-engagement to the camming at the next cycle. As much as one third of the cycle time was formerly used in returning the end working slide to the start of the new cycle.

The system of handling coolants and of disposing of chips from the green machining department is said to be unique in the metal-processing industry. A hole in the machine base directly beneath the spindle permits coolant and chips to fall directly into a sluiceway. Chips and coolant are separated, with the coolant recirculated into the coolant system, while the chips are automatically conveyed by means of a series of spiral and shaker conveyers to large trucks, returned to Timken's Canton Steel Mill, and remelted.

In order to carry out the Bucyrus concept of through-flow, it was necessary to develop entirely new heat-treating equipment and methods. This work was done in conjunction with Surface Combustion Corporation of Toledo, Ohio. The first heat-treating operation being carburizing, a spiral retort carburizing furnace was developed using carburizing atmosphere of endothermic gas and natural gas maintained in the retort at a slightly positive pressure. The carburizing temperature is 1700 F and the time cycle from $5^1/_2$ to 8 hr, with a resultant carburized case from approximately 0.025 in. to 0.040 in. as required. A maximum surface carbon of one per cent graduating down progressively to the core carbon of approximately 0.20 carbon is obtained.

These parts pass from the furnace into a sealed oil quench and are automatically picked up by another spiral conveyer and carried through a washer to remove excess oil and then mechanically fed into a reheat furnace for case refinement. There are two types of reheat furnaces. For smaller parts that do not distort excessively, another spiral retort of smaller dimensions was designed, and for the larger parts that tend to distort more, a continuous pusher furnace was developed with an automatic plug quench. In this case, the quenching machine was of completely new design.

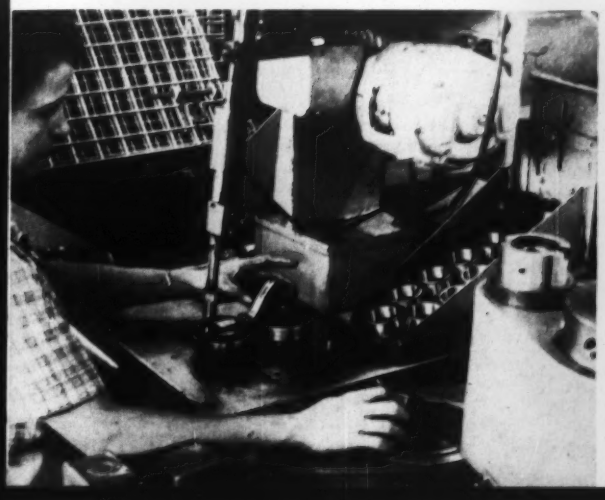
The reheat furnace has endothermic gas atmosphere and operates at 1510 F. The purpose of this operation is to bring the bearing parts up to furnace temperature and then quench them in oil. From the reheat furnaces the parts are carried through a washer and then into a final tempering operation operating at 360 F.

Improved methods of grinding and closer control have made it unnecessary to match cone and roll sizes. Grinding dimensions are held so closely that any cone can be assembled with standard size rolls, thus eliminating the need for selective assembly.

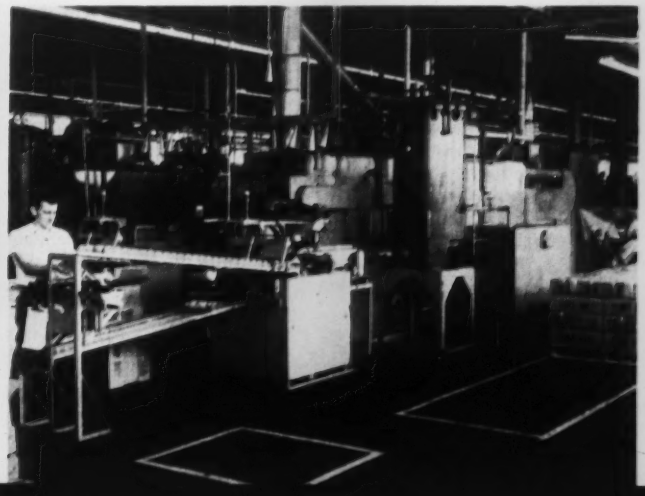
Two types of rib grinding machines are used. One is Timken-designed and incorporates a magnetic work driver, work supporting shoes, and a hollow or cupped grinding wheel. The second is a conventional Cincinnati Microcentric.

The loading mechanism on the Nos. 2 and 3 Cincinnati Centerless grinders is another noteworthy accomplishment of Timken's research team. Cups fall into

7 Close-up of operator on cone assembly. Magnetic elevator brings rollers into feeder tube that places rollers into cage. Assembly is put into closing in press, *right*, and ejected into conveyer.



8 The entire unit of final inspection, *right*, washing, drying, and slushing, *center*, and packaging, *left*, of cone assemblies is shown. The cone assemblies are packed into cardboard tubes by the machine and attendant seals the tops.



the loader from a gravity chute. Each stroke of the loading mechanism places cups in a horizontal column. Pressure is applied by a system of weights pushing the column of cups against the grinding wheel. It is important that the pressure be steady and that the cups feed through squarely. If the cups are not in a tight column, they may fall sideways resulting in an off-square grind. Too much pressure may cause an irregular finish on the OD surface.

Newly designed honing machines, using abrasive tape instead of honing stones as a honing medium, have been installed. With these machines the tape is advanced for each cup so that a new and identical abrasive surface is presented to each cup. A high degree of uniformity of finish, better clean-up of grind, and considerably improved control of stand and taper are therefore obtained. Close control is maintained at all finishing operations by means of air gages capable of a uniformly high degree of accuracy.

Cups and cones leaving the finishing departments are gaged by Moore Automatic Gages which simultaneously measure all the critical dimensions. In the case of cones, over-all length, outside diameter, taper and rib length, and in the case of cups it gages the stand, taper, OD, and length.

Interesting Side Lights

A central hydraulic system for internal grinding machines, a central coolant system for all grinding machines and screw machines, a central honing solution system for all the honing machines, and a central supply for high-frequency power for internal grinding wheel spindles were all especially designed for the Bucyrus plant.

Coolants and other solutions used in the operation of the plant are never, under any circumstance, released into surrounding streams.

Oil from these solutions is separated and returned to the boilerhouse where it is burned. Enough such oil is collected over a year's time to provide about 20 days' fuel for the boilers.

Water circulated through the plant is pumped into the reservoir where it is drawn upon by the boilerhouse for use as processed steam.

Each production line is divided into groups, and each group is paid a bonus on the basis of the number of pieces produced. As a direct result of the bonus-incentive system, a high degree of teamwork has been generated. All hourly rated employees participate in the program. Even those hourly rated employees not working directly on production participate in the over-all plant bonus. Average bonus paid last year was 25 per cent of base pay.

Supervision likewise differs greatly from many industrial concerns. At Timken's Bucyrus plant a foreman is not assigned to a particular department but is assigned to an area and is moved from one area to another.

Employees are likewise moved from department to department at intervals. This achieves not only a flexible production force, but eliminates to a marked degree boredom and monotony of employees who would otherwise be performing repetitious work.

ECPD and EJC Announce Joint Program for New York Meeting, October 24-25

C. E. Davies to address Silver Anniversary Dinner

THE preliminary program was announced recently for the joint presentation of the twenty-fifth annual meeting of the Engineers' Council for Professional Development and the fourth annual General Assembly of the Engineers Joint Council to be held at the Hotel Statler, New York, N. Y., on October 24 and 25. The American Society of Mechanical Engineers takes an important role in the activities of both these organizations.

The program, an expression of the essential unity and complementary nature of the goals and purposes of ECPD and EJC, will be presented in four sessions. C. E. Davies, secretary, ASME, will be the principal speaker at the ECPD Silver Anniversary Dinner on Thursday, October 24. The Thursday luncheon speakers, EJC President J. W. Barker, past-president and Fellow ASME, and M. D. Hoover, ECPD President, will discuss the Present and Future of ECPD and EJC. The College in Professional and Management Development, the theme for the Friday luncheon, will be covered by Dana Young, Fellow ASME, dean of engineering, Yale University.

The four sessions will develop the following significant themes.

The lead-off session is entitled "Top Management Gets the Word From the Scientists and Engineers: Technique—The Attitude Survey." Hugh L. Dryden, Fellow ASME, director, National Advisory Committee for Aeronautics, will lead the discussion by four authorities after giving a brief introduction explaining why the White House Committee believes some measure of scientists' and engineers' attitudes is necessary to overall study and why the Committee feels that industrial participation is extremely desirable.

The second session, under the title "The Community College and Technological Education," will consider the role of the two-year post-high-school curriculums in technological education in the next decade.

On Friday, the first session covering the place of the engineer in industrial management with stress on management training will be discussed by a panel of outstanding speakers.

The closing session, "New Dimensions in Postgraduate Education for the Young Engineers," will appraise trends in combining advance engineering education with engineering employment.

Meetings of Other Societies

Nov. 4–8

The American University, School of Government and Public Administration, current developments in automatic data processing systems, Washington, D. C.

Nov. 6–8

Instrument Society of America and American Institute of Electrical Engineers, annual conference on electronic techniques in medicine and biology, Boston, Mass.

Nov. 11–14

American Petroleum Institute, annual meeting, Conrad Hilton and Palmer House, Chicago, Ill.

Nov. 13–14

Institute of Radio Engineers, Mid-America Electronics Convention, Municipal Auditorium, Kansas City, Mo.

Nov. 13–15

American Standards Association, eighth national conference, St. Francis Hotel, San Francisco, Calif.

Nov. 13–16

The Society of Naval Architects and Marine Engineers, annual meeting, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 14–16

The American Society of Refrigerating Engineers, semi-annual meeting, Morrison Hotel Chicago, Ill.

(ASME Coming Events—see page 1001)

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

1957 ASME Annual Meeting Program Keeps Pace With Engineering Progress

Hotels Statler and Sheraton-McAlpin again to be headquarters for one of New York City's most important technical meetings

PLANS for the 1957 Annual Meeting of The American Society of Mechanical Engineers to be held December 1 through 6, at the Hotels Statler and Sheraton-McAlpin, New York, N. Y., are well under way with more than 140 technical sessions scheduled during the five-day program. It is anticipated that better than 7500 persons will attend the Annual Meeting which offers a large variety of technical subjects as well as several general sessions, social events, and inspection trips.

The meeting will officially open on Sunday afternoon, December 1, with registration commencing at 2:00 p.m., in both of the Headquarters hotels. The registration desks for the meeting will be located in the Grand Ballroom foyer of the Hotel Statler and the Second Mezzanine of the Hotel Sheraton-McAlpin. Registration for the women's events will be conducted in the Pennsylvania Room of the Hotel Statler.

Following its practice of the past year, the Council will commence its sessions on Saturday, November 30, at 1:00 p.m. These sessions, of course, are open to members of the Society.

Feature Events

Following the Sunday afternoon registration period, the Metropolitan Section of the Woman's Auxiliary of the ASME will conduct an "Early Bird" Party at the National Arts Club located at Gramercy Square, New York City. At this function, members and guests will have an opportunity to make early acquaintances with both new and old friends. Among the high lights of Monday's program, is the President's Luncheon at which an address will be made by ASME President William F. Ryan. Following the President's Luncheon will be the Annual Tea Dance sponsored by the Metropolitan Section of the Woman's Auxiliary of the ASME and the Society Business Meeting at 4:45 p.m.

Tuesday's program will feature many prominent events, among which are four professional division's luncheons. The Fuels—Nuclear Engineering—Power Luncheon will be addressed by Admiral Lewis L. Strauss, Chairman of the United States Atomic Energy Commission. The Heat Transfer Division Luncheon will hear an address by W. D. Leggett, Jr., vice-president of engineering, Alco Products, Inc. The Management Division Luncheon will feature the 1957 recipient of the Gantt Medal. R. B. Smith, Mem. ASME, vice-president, The M. W. Kellogg Company, will speak at the Petroleum Luncheon. The Roy V. Wright Lecture will be delivered at the Annual Meeting by The Honorable Joseph B. Johnson, Governor of the State of Vermont. The Honorable Ralph E. Flanders, past-president and Hon. Mem. ASME, and U. S. Senator from Vermont, will introduce Governor Johnson. On Tuesday evening, several events are offered including the perennial Hydraulic Old Timers Stag Dinner and the Applied Mechanics Dinner. At 8:00 p.m., the Metropolitan Section of the Woman's Auxiliary will sponsor a Hawaiian Night which will include authentic entertainment and refreshment.

The Annual Members and Students Luncheon will be held on Wednesday, rather than Thursday, as has been the custom in the past. One of the speakers at the luncheon will be George M. Reynolds of Northwestern University, Evanston, Ill. (Region VI, Southern Tier) who won the Student Paper Competition sponsored by the Old Guard of the Society, for his paper "Computer Control of Machine Tools." Sharing the limelight will be 1957 recipient of

Registration Schedule

Sunday,	December 1, 2:00 p.m. to 5:00 p.m.
Monday,	December 2, 8:00 a.m. to 8:00 p.m.
Tuesday,	December 3, 8:00 a.m. to 8:00 p.m.
Wednesday,	December 4, 8:00 a.m. to 3:00 p.m.
Thursday,	December 5, 8:00 a.m. to 8:00 p.m.
Friday,	December 6, 8:00 a.m. to 3:00 p.m.

the Pi Tau Sigma Gold Medal Award. The high light of Wednesday's program will be the Annual Banquet which, in addition to being the occasion for the bestowal of Society honors that are presented during it, will feature an address by Henry T. Heald, Mem. ASME, president of the Ford Foundation, New York, N. Y. Following the Banquet there will be dancing.

Two major luncheons and three dinners highlight Thursday's program of feature events. The Textile Engineering Division Luncheon will be addressed by John P. Baum, vice-president of J. P. Stevens & Company, Inc. The Wood Industries Division Luncheon will feature an address by L. J. Markwardt, assistant director of the U. S. Forest Products Laboratory. Among the dinners planned for this day, the Nuclear Engineering Division will hear addresses by Francis K. McCune, Mem. ASME, vice-president, Atomic Division, General Electric Company, and Prof. Theodore Baumeister of Columbia University and General Public Utilities Corporation. The Power Test Codes Committee will also conduct a dinner on Thursday evening featuring a prominent speaker in the Power Test Codes field. The Annual Honors Night Dinner of the American Rocket Society will be held on this evening in the Grand Ballroom of the Hotel Statler.

Inspection and Plant Trips

Although specific information is not presently available, several plant trips are being planned during the week of the Annual Meeting. Complete details will be announced in the advance program of the meeting. Watch for your copy which will be mailed on or about the fifteenth of October.

College Reunions

Many of the members of ASME who will be attending technical sessions during the Annual Meeting will also have an opportunity at that time to participate in a reunion of their colleges. In most instances, these reunions will be held on Thursday, December 5. Upon registering it is suggested that members and guests interested in college reunions contact the ASME staff member at the College Reunion Desk located in the Grand Ballroom Foyer of the Hotel Statler.

Hall of Fame Ceremony

On Sunday afternoon, December 1, a special ceremony will take place at the Hall of Fame located at New York University, at which the bust of George Westinghouse will be unveiled.

The Technical Sessions

All ASME technical sessions will be held in either the Hotel Statler or Sheraton-McAlpin. The advance program, to be mailed about October 15, will contain information as to the specific location of these sessions and it is suggested that members and guests for their own convenience make reservations at the hotel in which the sessions they are most interested in are being scheduled.

The tentative program of technical sessions follows:

AIR POLLUTION CONTROLS SESSION

I TUESDAY, DECEMBER 3 2:30 p.m.
Engineering Problems in Controlling Automobile Exhaust Gases[1]

AMERICAN ROCKET SOCIETY PROGRAM

Ia TUESDAY, DECEMBER 3 9:30 a.m.
Combustion

Ib TUESDAY, DECEMBER 3 9:30 a.m.
Solid Rockets

L TUESDAY, DECEMBER 3 12:15 p.m.
Section Delegates Luncheon

IIa TUESDAY, DECEMBER 3 2:30 p.m.
Propellants

IIb TUESDAY, DECEMBER 3 2:30 p.m.
Ramjet

IIIa WEDNESDAY, DECEMBER 4 9:30 a.m.
Instrumentation

IIIb WEDNESDAY, DECEMBER 4 9:30 a.m.
Space Law and Sociology

L WEDNESDAY, DECEMBER 4 12:15 p.m.
New York Section Luncheon

IVa WEDNESDAY, DECEMBER 4 2:30 p.m.
Liquid Rocket

IVb WEDNESDAY, DECEMBER 4 2:30 p.m.
Human Factors

Va THURSDAY, DECEMBER 5 9:30 a.m.
Space Flight Symposium

Vb THURSDAY, DECEMBER 5 9:30 a.m.
Guidance

VIa THURSDAY, DECEMBER 5 2:30 p.m.
Classified Session on Propellants and Combustion

VIb THURSDAY, DECEMBER 5 2:00 p.m.
Guidance

D THURSDAY, DECEMBER 5 7:00 p.m.
Honors Night Dinner

[1] Papers not available—see box on page 989.

High Lights of the 1957 Annual Meeting

SUNDAY, DECEMBER 1

5:00 p.m. "Early Bird" Party
National Arts Club

MONDAY, DECEMBER 2

12:15 p.m. President's Luncheon
4:00 p.m. Tea Dance
4:45 p.m. Business Meeting

TUESDAY, DECEMBER 3

12:15 p.m. Fuels—Nuclear Engineering—Power Luncheon
12:15 p.m. Heat Transfer Luncheon
12:15 p.m. Management Luncheon
12:15 p.m. Petroleum Luncheon
5:00 p.m. Roy V. Wright Lecture
6:30 p.m. Hydraulic Old Timers Stag Dinner
6:30 p.m. Applied Mechanics Dinner
Men's Faculty Club, Columbia University
8:00 p.m. Woman's Auxiliary Hawaiian Night

WEDNESDAY, DECEMBER 4

12:15 p.m. Members and Students Luncheon
7:00 p.m. Banquet
10:00 p.m. Dancing

THURSDAY, DECEMBER 5

12:15 p.m. Textile Engineering Luncheon
12:15 p.m. Wood Industries Luncheon
6:30 p.m. Nuclear Engineering Dinner
6:30 p.m. Power Test Codes Dinner
7:00 p.m. American Rocket Society Honors Night Dinner

L FRIDAY, DECEMBER 6 12:15 p.m.
ARS Luncheon

ANNUAL BANQUET

B WEDNESDAY, DECEMBER 4 7:00 p.m.
ASME Annual Banquet
Address by: *Henry T. Heald*, President, Ford Foundation, New York, N. Y.

Orders for ASME Technical Papers

ONLY copies of *numbered* ASME papers will be available. Please order only by paper *number;* otherwise the order will be returned. Order your copies of *numbered* papers by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Production problems may delay the availability of some numbered papers. However, orders will be held for such papers only until Nov. 15, 1957.

Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $2 to members; $4 to nonmembers.

Copies of unnumbered papers, listed in this program, *are not available* in advance of the meeting because the review of these manuscripts had not been completed when the program went to press. The author's name and company affiliation will appear with paper title in the final program (final program available only at meeting).

The January, 1958, issue of MECHANICAL ENGINEERING will contain a complete listing of all available papers.

APPLIED MECHANICS SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Displacement Discontinuity in the Elastic Half-Space, by *Leif Rongved*, Bell Telephone Labs, Inc., and *J. T. Fraster*, Penn State U (Paper No. 57—A-23)

Stress Distribution Around a Circular Inclusion in a Semi-Infinite Elastic Plate, by *Ernesto Maximo Saleme*, Universidad Nacional de Tucuman, Tucuman, Argentina (Paper No. 57—A-18)

Thermal Stresses in Transversely Isotropic Semi-Infinite Elastic Solids,[2] by *Brahmadev Sharma*, Saugor, Madhya Pradesh, India (Paper No. 57—A-22)

Contact Stresses Under Combined Pressure and Twist, by *M. Hetenyi*, Northwestern U, and *P. H. McDonald, Jr.*, N. C. State College (Paper No. 57—A-95)

Stress-Strain Relations for a Simple Model of a Granular Medium,[2] by *H. Deresiewicz*, Columbia U (Paper No. 57—A-90)

Effect of Curvature on the Hertz Theory for Two Circular Cylinders in Contact,[2] by *Tsu-Tao Loo*, formerly with Rensselaer Poly Inst (Paper No. 57—A-33)

The Pressure for Indenting Material Resting on a Rough Foundation,[2] by *W. Johnson*, Manchester U, Manchester, England, and *D. M. Woo*, Sheffield U, Sheffield, England (Paper No. 57—A-24)

[1] Paper not available—see box on this page.
[2] Not presented orally.

II MONDAY, DECEMBER 2 2:30 p.m.

The Bending of Pretwisted Thin-Walled Beams of Symmetric Star-Shaped Cross-Sections,[2] by *L. Maunder*, U of Edinburgh, Edinburgh, Scotland (Paper No. 57—A-84)

Nonaxial Bending of Ring-Plates of Varying Thickness, by *H. D. Conway*, Cornell U (Paper No. 57—A-92)

On the Bounds of Eigenvalues of a Clamped Plate in Tension, by *R. K. Kaul*, Columbia U, and *S. G. Tewari*, National Physical Lab of India, New Delhi, India (Paper No. 57—A-32)

Buckling of a Thin Annular Plate Under Uniform Compression,[2] by *N. Yamaki*, Tohoku U, Sendai, Japan (Paper No. 57—A-11)

Bending of an Elastically Restrained Circular Plate Under Normal Loading Over a Sector,[2] by *W. A. Bassali*, Alexandria U, Alexandria, Egypt, and *R. H. Dawoud*, Cairo U, Giza, Egypt (Paper No. 57—A-8)

Axially Symmetric Motions of Thick Cylindrical Shells, by *I. Mirsky*, Foster Wheeler Corp., and *G. Herrmann*, Columbia U (Paper No. 57—A-19)

General Instability of Ring-Stiffened Cylindrical Shells Subject to External Hydrostatic Pressure—A Comparison of Theory and Experiment, by *G. D. Galletly*, Shell Oil Development Co., *R. C. Slankard*, Headquarters USAF, and *E. Wenk, Jr.*, Southwest Research Inst (Paper No. 57—A-73)

III MONDAY, DECEMBER 2 8:00 p.m.

An Approximate Analysis of Timoshenko Beams Under Dynamic Loads, by *B. A. Boley* and *Chi Chang Chao*, Columbia U (Paper No. 57—A-17)

Coupled Vibrations of Thin Walled Beams of Open Cross Section, by *J. M. Gere*, Stanford U, and *Y. K. Lin*, Vertol Aircraft Corp. (Paper No. 57—A-26)

On the Transverse Vibrations of Rectangular Orthotropic Plates, by *N. J. Huffington, Jr.*, Va Poly Inst, and *W. H. Hoppmann, 2nd*, Johns Hopkins U (Paper No. 57—A-85)

IV TUESDAY, DECEMBER 3 9:30 a.m.

Reflection of an Acoustic Step Wave From an Elastic Cylinder, by *Richard Skalak* and *M. B. Friedman*, Columbia U (Paper No. 57—A-7)

The Nature of Axisymmetric Wave Fields, by *H. A. Lang*, The Rand Corp. (Paper No. 57—A-21)

Spherical Symmetry in the Theory of Elasticity,[2] by *F. Goded*, General Electrica Espanola, Madrid, Spain (Paper No. 57—A-119)

Comments on the Cutting of Metal Plates With High Explosive Charges,[2] by *W. E. Drummond*, Stanford Research Inst (Paper No. 57—A-89)

V TUESDAY, DECEMBER 3 2:30 p.m.

On the Dynamical Behavior of Rotating Shafts Driven by Universal (Hooke) Couplings, by *R. M. Rosenberg*, U of California (Paper No. 57—A-1)

Effect of Finite Rotations on Gyroscopic Sensing Devices, by *I. E. Goodman* and *A. R. Robinson*, U of Minnesota (Paper No. 57—A-30)

Kinematic Drift of Single-Axis Gyroscopes, by *R. H. Cannon, Jr.*, North American Aviation, Inc. (Paper No. 57—A-72)

Unbalanced Inertia Forces in Slider-Crank Mechanisms of Large Eccentricity, by *Ernst Mewes*, Institut für Landtechnische Grundlagenforschung der Forschungsanstalt für Landwirtschaft, Braunschweig, Germany (Paper No. 57—A-41)

D TUESDAY, DECEMBER 3 6:30 p.m.

Applied Mechanics Dinner

VI WEDNESDAY, DECEMBER 4 9:30 a.m.

Co-ordinates Which Uncouple the Equations of Motion of Damped Linear Dynamic Systems, by *K. A. Foss*, M.I.T. (Paper No. 57—A-86)

Velocity and Acceleration Analysis of Plane and Space Mechanisms by Means of Independent-Position Equations, by *F. H. Raven*, Cornell U (Paper No. 57—A-2)

Torques on a Satellite Vehicle From Internal Moving Parts, by *R. E. Roberson*, North American Aviation, Inc. (Paper No. 57—A-39)

VII WEDNESDAY, DECEMBER 4 2:30 p.m.

Carrying Capacity of an Elastic-Plastic Cylindrical Shell With Linear Strain Hardening, by *P. G. Hodge, Jr.*, and *S. V. Nardo*, Poly Inst Brooklyn (Paper No. 57—A-5)

Redundant Trusses of Elastic-Strain-Hardening Material,[2] by *Hans Ziegler*, Eidgenoessische Technische Hochschule, Zurich, Switzerland (Paper No. 57—A-28)

A Compressible Elastic-Perfectly Plastic Wedge, by *D. R. Bland*, U of Manchester, Manchester, England, and *P. M. Naghdi*, U of Michigan (Paper No. 57—A-38)

On Plane Stress Solution of an Elastic-Perfectly Plastic Wedge, by *P. M. Naghdi*, U of Michigan (Paper No. 57—A-40)

An Experimental Study of Initial and Subsequent Yield Surfaces in Plasticity, by *P. M. Naghdi, Frank Essenburg*, and *W. Koff*, U of Michigan (Paper No. 57—A-37)

VIII THURSDAY, DECEMBER 5 9:30 a.m.

Creep Deflections and Stresses of Beam Columns, by *T. H. Lin*, U of California (Paper No. 57—A-3)

Torsion of Cylindrical and Prismatic Bars in the Presence of Steady Creep, by *S. A. Patel, B. Venkatraman*, and *P. G. Hodge, Jr.*, Poly Inst Brooklyn (Paper No. 57—A-27)

The Bursting Pressure of Cylindrical and Spherical Vessels,[2] by *N. L. Svensson*, Imperial College of Science and Technology, London, England (Paper No. 57—A-15)

Further Studies of Stress Distribution in Rotating Disks and Cylinders Under Elevated Temperature Creep Conditions, by *A. M. Wahl*, Westinghouse Research Labs (Paper No. 57—A-91)

IX THURSDAY, DECEMBER 5 2:30 p.m.

Further Large Deflection Analysis for a Plate Strip Subjected to Normal Pressure and Heating, by *M. L. Williams*, Calif Inst Tech (Paper No. 57—A-14)

Stress Distributions Around Hydrostatically Loaded Circular Holes in the Neighborhood of Corners, by *A. J. Durelli* and *A. S. Kobayashi*, Armour Research Foundation (Paper No. 57—A-4)

A New Method to "Lock In" Elastic Effects for Experimental Stress Analysis, by *J. W. Dally, A. J. Durelli*, and *W. F. Riley*, Armour Research Foundation (Paper No. 57—A-71)

X THURSDAY, DECEMBER 5 8:00 p.m.

Some Basic Properties of Shoe Brakes, by *G. A. G. Fazekas*, AMF (Paper No. 57—A-6)

A Blade-Vibration-Damping Device—Its Testing and a Preliminary Theory of Its Operation, by *R. A. De Taranto*, RCA (Paper No. 57—A-10)

The Calculation of Optimum Concentrated Damping for Continuous Systems, by *R. Plunkett*, Gen Elec. Co. (Paper No. 57—A-93)

On the Sloshing of Liquid in a Flexible Tank,[2] by *J. W. Miles*, U of California (Paper No. 57—A-12)

Ring Damping of Free Surface Oscillations in a Circular Tank, by *J. W. Miles*, U of California (Paper No. 57—A-31)

XI FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Nuclear Engineering

See Nuclear Engineering VII

AVIATION SESSIONS

Ia MONDAY, DECEMBER 2 9:30 a.m.

Jointly with SAE

Operational Support for Turbine-Powered and Cargo Aircraft—Part 1

What's New in Transport Aircraft[1]

Air Force Experience and Planning for Ground Support Equipment for Jet and Cargo Aircraft[1]

Ground Equipment Requirements for Tomorrow's Transport Aircraft[1]

Ib MONDAY, DECEMBER 2 9:30 a.m.

Jointly with Instruments and Regulators

Flight Test Instrumentation

Selecting Instrumentation Systems for Flight Research-Test Programs[1]

Advanced Flight-Instrumentation Techniques Used to Develop Turbojet Engines[1]

Design Analysis of a Helicopter-Rotor Governor[1]

II a **MONDAY, DECEMBER 2** **2:30 p.m.**

Operational Support for Turbine-Powered and Cargo Aircraft—Part 2

Servicing and Loading Equipment[1]

Turbine-Aircraft Fueling Facilities[1]

The Economics of Ground Support Equipment[1]

II b **MONDAY, DECEMBER 2** **2:30 p.m.**

Accessories for High Mach Flight

System and Accessory Problems in the High-Speed Regime[1]

Hydraulic Component and System Considerations for High Mach Flight[1]

The Effect of Power Extraction on Turbojet Engines[1]

III **TUESDAY, DECEMBER 3** **9:30 a.m.**

Jointly with Materials Handling

Operational Support for Turbine-Powered and Cargo Aircraft—Part 3

Engineering Objectives for Improved Passenger Service[1]

Air-Freight Operation[1]

Airport-Terminal Design for Passenger Comfort and Convenience[1]

IV a **TUESDAY, DECEMBER 3** **2:30 p.m.**

Jointly with Safety

Operational Support for Turbine-Powered and Cargo Aircraft—Part 4

The Generation of Noise, Its Effect on Man, Structures, and Operations[1]

What New Problems Are Being Created by This Noise Situation for Which Answers Must Be Found[1]

A Systems Approach to the Jet Noise Problem[1]

IV b **TUESDAY, DECEMBER 3** **2:30 p.m.**

Jointly with Gas Turbine Power

See Gas Turbine Power IV

V **WEDNESDAY, DECEMBER 4** **9:30 a.m.**

Jointly with Gas Turbine Power

Helicopter Gas Turbines

T58 in Flight[1]

Turboshaft Engine Development Programs to Meet Navy Helicopter Requirements[1]

Early Experiences in Flight Tests With T53-Powered Helicopters[1]

VI **WEDNESDAY, DECEMBER 4** **2:30 p.m.**

Jointly with Gas Turbine Power

Applications for Small Aircraft Gas Turbines

The Gas Turbine for Vertical Rising Aircraft[1]

A New Concept in Light-Weight Aircraft[1]

Economics of Small Gas-Turbine Applications

VII **THURSDAY, DECEMBER 5** **9:30 a.m.**

Jointly with Gas Turbine Power

See Gas Turbine Power VII

BOILER FEEDWATER STUDIES SESSIONS

I **TUESDAY, DECEMBER 3** **9:30 a.m.**

The Relation of Ferrous Hydroxide to the Corrosion of Iron by Water[1]

The Effect of Mechanical Factors on Condensate System Corrosion[1]

II **TUESDAY, DECEMBER 3** **2:30 p.m.**

Jointly with Power

Diet for Boiler Allergies[1]

Ammonia and Hydrazine for High-Pressure Boilers[1]

III **WEDNESDAY, DECEMBER 4** **9:30 a.m.**

Jointly with Power

See Power VII

CONSULTING ENGINEERING SESSION

I **MONDAY, DECEMBER 2** **9:30 a.m.**

EDUCATION SESSIONS

I **MONDAY, DECEMBER 2** **2:30 p.m.**

Engineering Science, the Core of Engineering Training[1]

The Engineering in an Engineering Curriculum[1]

Integration of Know-How and Knowledge[1]

II **MONDAY, DECEMBER 2** **8:00 p.m.**

Jointly with Machine Design and Management

See Machine Design III

EFFECT OF TEMPERATURE ON METALS SESSION

I **TUESDAY, DECEMBER 3** **8:00 p.m.**

Jointly with Metals Engineering

Oxidation of Superheater Materials by High-Temperature Steam, by *John H. Hoke* and *F. Eberle*, Babcock & Wilcox Co. (Paper No. 57—A-175)

Investigation of the Suitability of 18-8 (Type 304) Alloy for Superheater Service With Respect to Corrosion and Stress-Corrosion Behavior in Chloride-Bearing Steam Condensate, by *F. Eberle, T. A. McNary*, and *Fred B. Snyder*, Babcock & Wilcox Co. (Paper No. 57—A-174)

Properties of Cast Iron at Elevated Temperatures—A Progress Report[1]

FLUID METERS SESSIONS

I **WEDNESDAY, DECEMBER 4** **9:30 a.m.**

Liquid Flowmeter Calibration Techniques, by *M. R. Shafer* and *F. W. Ruegg*, Nat Bu Standards (Paper No. 57—A-70)

Flow Straightener for Close Measurement, by *R. E. Sprenkle* and *N. S. Courtright*, Bailey Meter Co. (Paper No. 57—A-76)

Dimensionless Correlation of Coefficients of Turbine-Type Flowmeters, by *H. M. Hochreiter*, Fischer & Porter Co. (Paper No. 57—A-63)

II **WEDNESDAY, DECEMBER 4** **2:00 p.m.**

Analysis of the Effect of Pulsations on the Response of Mercurial-Type Differential Pressure Recorders, by *R. J. Martin* and *D. S. Moseley, Sr.*, Southwest Research Inst (Paper No. 57—A-82)

A Method for Predicting Supercompressibility Factors of Natural Gases, by *R. H. Zimmermann* and *S. R. Beitler*, Ohio State U, and *R. G. Darrow*, Columbia Gas System Service Corp. (Paper No. 57—A-69)

Subcritical and Critical Flow Through Straight-Through, Elbow, and Tee A-N Fittings and Sharp-Edged Orifices at Elevated Temperatures, by *A. L. Ducoffe, J. R. Bennett*, and *C. Gable Ray*, Ga. Inst Tech (Paper No. 57—A-60)

III **THURSDAY, DECEMBER 5** **2:30 p.m.**

Jointly with Power Test Codes and Power

See Power Test Codes

FUELS SESSIONS

I **MONDAY, DECEMBER 2** **9:30 a.m.**

New Concepts in Stoker Design[1]

Problems in the Development of the BCR Automatic Coal-Fired Packaged Steam Generator[1]

Development and Operating Experience of the Jet-Ignition Stoker[1]

II **MONDAY, DECEMBER 2** **2:30 p.m.**

Steam From By-Product Industrial Gases[1]

Steam From By-Products Fuels, by *J. B. Walker, Jr.*, Babcock & Wilcox Co. (Paper No. 57—A-126)

Conversion of Boilers[1]

III **TUESDAY, DECEMBER 3** **9:30 a.m.**

Economics of Heating and Power Systems for Large Industrial Plants, by *W. T. Batcheller*, Seattle, Wash. (Paper No. 57—A-123)

The Combined Steam and Gas Turbine Supercharged Boiler Cycle and Its Fuels[1]

Supercharger for Pressure Fired Boilers[1]

L **TUESDAY, DECEMBER 3** **12:15 p.m.**

Jointly with Nuclear Engineering and Power

Fuels Luncheon

Address by: *Admiral L. L. Strauss*, Chairman, United States Atomic Energy Commission, Washington, D. C.

IV **TUESDAY, DECEMBER 3** **2:30 p.m.**

Jointly with Power

Incremental Cost of Burning Coal in Utility-Generating Stations[1]

Application of Bonus-Penalty Method to Coals Being Purchased or Evaluated, by *R. N. Schaffer* and *F. H. Strout*, Northern Indiana Public Service Co., and *G. W. Land*, Truax-Traer Coal Co. (Paper No. 57—A-115)

Effects of Particle Size on Firing Pulverized Solid Fuels in Boilers[1]

Fuel-Handling Systems at the Burlington Station, Public Service Electric and Gas Company[1]

V **WEDNESDAY, DECEMBER 4** **9:30 a.m.**

Jointly with Furnace Performance Factors and Corrosion and Deposits

See Furnace Performance Factors Session

FURNACE PERFORMANCE FACTORS-CORROSION AND DEPOSITS SESSION

I **WEDNESDAY, DECEMBER 4** **9:30 a.m.**

Jointly with Fuels

Sulfuric Acid Corrosion in Oil-Fired Boilers—Studies on Sulfur Trioxide Formation[1]

Effect of Temperature Variation on Composition, Fouling Tendency, and Corrosiveness of Combustion Gas From a Pulverized-Fuel-Fired Steam Generator[1]

An Investigation of the Variation in Heat Absorption in a Pulverized-Coal-Fired Slag-Tap Steam Boiler at Blaine Island[1]

Official Notice

ASME Business Meeting

THE Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held on Monday afternoon, Dec. 2, 1957, at 4:45 p.m., at the Hotel Statler, New York, N. Y., as part of the Annual Meeting of the Society.

Members are urged to attend.

GAS TURBINE POWER SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Industrial

External Equipment for the Stationary Gas Turbine, by *D. L. E. Jacobs* and *I. H. Landes*, Gen. Elec. Co. (Paper No. 57—A-142)

Gas Turbines for Process Application, by *D. F. Bruce*, Westinghouse Elec. Corp. (Paper No. 57—A-140)

Operating Experience With 750/1000-KW Gas Turbine, by *G. B. R. Feilden*, Ruston & Hornsby Ltd., Lincoln, England, and *T. P. Latimer*, Clark Brothers

II MONDAY, DECEMBER 2 2:30 p.m.

Jointly with Hydraulic

Compressors

Compressor Development for Small Gas Turbines[1]

A Simple Method of Estimating the Reynolds Number Effects on Aircraft Gas Turbine Engines Operating at High Altitudes, by *R. W. Pinnes*, Bu of Aero (Paper No. 57—A-157)

Effects of Stage Characteristics and Matching on Axial Flow Compressor Performance, by *Aubrey Stone*, Solar Aircraft Co. (Paper No. 57—A-139)

III TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Nuclear Engineering

Nuclear-Gas Turbines

Component Optimizations for Nuclear-Powered Closed-Cycle Gas-Turbine Power Plants[1]

High-Temperature Gas-Cycle Reactor Power Systems

IV TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Aviation

Aircraft Gas Turbines—Turbines and Combustors

Operational Experience With Auxiliary Gas Turbines for Aircraft, by *C. H. Paul*, AiResearch Manufacturing Co. (Paper No. 57—A-121)

Ideal Performance of Valved-Combustors and Applicability to Several Engine Types, by *A. W. Goldstein* and *J. F. Klapproth*, NACA, and *M. J. Hartman*, NACA, Lewis Flight Propulsion Lab (Paper No. 57—A-102)

Rearrangement of the Temperature Field in Flow Around a Bend[1]

V WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Aviation

See Aviation V

VI WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Aviation

See Aviation VI

VII THURSDAY, DECEMBER 5 9:30 a.m.

Jointly with Aviation

Aviation

Aerodynamic Development of a Turbojet Engine, by *G. H. Pedersen*, Curtis-Wright Corp. (Paper No. 57—A-127)

Getting a Civil Turboprop Into Service, by *B. G. Markham*, Bristol Aero-Engines, Ltd., Bristol, England (Paper No. 57—A-132)

Developing an Aircraft Gas Turbine, by *M. S. Saboe*, AVCO Manufacturing Corp. (Paper No. 57—A-143)

HEAT TRANSFER SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Transient Heat Transfer

Blowdown and Charging Processes in a Single Gas Receiver With Heat Transfer, by *W. C. Reynolds* and *W. M. Kays*, Stanford U (Paper No. 57—A-137)

Hydraulic Analogy for Transient Cross-Flow Heat Exchangers, by *S. Juhasz*, Southwest Research Inst (Paper No. 57—A-125)

The Transient Response of a Two-Fluid Counter-Flow Heat Exchanger, The Gas-Turbine Regenerator, by *R. M. Cima* and *A. L. London*, Stanford U (Paper No. 57—A-135)

Charts and Elastic Thermal Stresses in Heating and Cooling of Slabs and Cylinders[1]

II MONDAY, DECEMBER 2 2:30 p.m.

Radiant Heat Transfer

Radiant Heating of Transparent Materials,[1] by *Robert Gardon*, Mellon Inst. of Industrial Research, and *E. R. Michalik*, Pittsburgh Plate Glass Co. (Paper No. 57—A-51)

Unified Treatment for Thermal Radiation Transfer Processes, by *Benjamin Gebhart*, Cornell U (Paper No. 57—A-34)

Temperature Profiles in Radiation-Cooled Turbine Wheels, by *J. G. Bartas*, Gen. Elec. Co. (Paper No. 57—A-122)

III TUESDAY, DECEMBER 3 9:30 a.m.

Transient Temperature Distribution and Thermal Stresses Resulting From Aerodynamic Heating of the Skin of a Hypersonic Vehicle With Variable Coefficients of Heat Transfer and Variable Adiabatic Wall Temperatures, by *Shih Yuan Chen*, Republic Aviation Corp. (Paper No. 57—A-9)

The Heat Transfer to a Turbulent Boundary Layer Downstream of an Injection Slot, by *R. A. Seban* and *H. W. Chan*, U of California, and *Steve Scesa*, Aeronutronic Systems, Inc. (Paper No. 57—A-36)

Thermal Transfer in Turbulent Gas Streams—Effect of Turbulence on Macroscopic Transport From Spheres, by *K. Sato* and *B. H. Sage*, Calif. Inst Tech (Paper No. 57—A-20)

L TUESDAY, DECEMBER 3 12:15 p.m.

Heat Transfer Luncheon

Presider: *S. Kopp*, chairman, ASME Heat Transfer Division; product manager, Special Engineered Products, Alco Products, Inc., Dunkirk, N. Y.

Speaker: *W. D. Leggett, Jr.*, Rear Admiral, USN Retired; vice-president, engineering Alco Products, Inc., Schenectady, N. Y.

Subject: **The Heat-Transfer Engineer in Today's Engineering Activity**

IV TUESDAY, DECEMBER 3 2:30 p.m.

Heat Exchangers

Effects of Tube-Bundle-to-Shell Clearance on Pressure Drop and Heat Transfer in Shell-and-Tube Heat Exchangers, by *B. E. Short* and *B. F. Treat*, U of Texas (Paper No. 57—A-49)

The Effect of Flow Distribution on Heat-Exchanger Performance, by *W. H. Comtois*, Combustion Engineering, Inc. (Paper No. 57—A-112)

Heat-Transfer and Pressure-Drop Characteristics of Internal Finned Tubes, by *J. E. Myers*, Purdue U, *E. Brouillette*, Lockheed Aircraft Corp., and *T. Mifflin*, Purdue U (Paper No. 57—A-47)

V TUESDAY, DECEMBER 3 8:00 p.m.

Jointly with Process Industries

See Process Industries I

VI WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Nuclear Engineering

Heat Transfer in Nuclear Equipment Design

An Analytical Method of Predicting Temperature Gradients in Thick Walled Pressure Vessels[1]

Prediction of the Pressure Loss and Density Factors for Two-Phase Annular Flow With or Without Heat Generation, by *J. C. Westmoreland*, Gen. Elec. Co. (Paper No. 57—A-50)

Boiling Heat Transfer to Water Containing a Volatile Additive, by *George Leppert*, Stanford U, *B. M. Hoglund*, Argonne National Lab, and *C. P. Costello*, Stanford U (Paper No. 57—A-81)

Vapor Formation and Behavior in Boiling Heat Transfer, by *R. A. Egen, D. A. Dingee*, and *J. W. Chastain*, Battelle Memorial Inst (Paper No. 57—A-74)

VII WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Power

Symposium: Welding of Nonferrous Tubes to Tube Sheets

Mechanical Effects Resulting From Welding Copper-Base Alloy Tubes to Tube Sheets[1]

Metallurgical Problems[1]

Field Experience in Welding Tubes in a Large Condenser[1]

VIII THURSDAY, DECEMBER 5 9:00 a.m.

Local Laminar Heat-Transfer Coefficients in Wedge-Shaped Passages, by *K. R. G. Eckert, T. F. Irvine, Jr.*, and *J. T. Yen*, U of Minnesota (Paper No. 57—A-133)

Effect of Vibration on Heat Transfer From a Wire to Air in Parallel Flow, by *K. Anantanarayanan* and *A. Ramachandran*, Indian Inst of Science, Bangalore, India (Paper No. 57—A-100)

IX THURSDAY, DECEMBER 5 2:30 p.m.

Comparison of Total Emittances With Values Computed From Spectral Measurements, by *J. T. Bevans*, Shell Development Corp., and *J. T. Gier*, and *R. V. Dunkle*, U of California (Paper No. 57—A-29)

Resistance Welding of Platinum Ten Per Cent Rhodium Wire to Platinum Sheet to Produce a Well-Defined Thermocouple Junction, by *C. E. Moeller*, Midwest Research Inst (Paper No. 57—A-118)

An Investigation of Effective Thermal Conductivities of Powders in Various Gases, by *R. G. Deissler* and *J. S. Boegli*, NACA, Lewis Flight Propulsion Lab (Paper No. 57—A-110)

X THURSDAY, DECEMBER 5 8:00 p.m.

The Variable Fluid Property Problem in Free Convection, by *E. M. Sparrow* and *J. L. Gregg*, NACA, Lewis Flight Propulsion Lab (Paper No. 57—A-46)

Laminar Film Condensation of Pure Saturated Vapors on Inclined Circular Cylinders, by *Kamal-Eldin Hassan*, U of Cairo, Orman, Giza, Egypt, and *Max Jakob*, Ill. Inst of Tech (Paper No. 57—A-35)

An Experimental Investigation of Film Characteristics in Horizontal Annular Two-Phase Flow, by *H. N. McManus, Jr.*, Cornell U (Paper No. 57—A-144)

HYDRAULIC SESSIONS

Ia MONDAY, DECEMBER 2 9:30 a.m.

Fluid Power Systems

Application of the Analog Computer to Product Dynamic Performance in Typical Hydraulic Circuits, by *Gerhard Reethof*, Vickers, Inc. (Paper No. 57—A-97)

Hydraulic Controls of Grinding Machines[1]

Ib MONDAY, DECEMBER 2 9:30 a.m.

Symposium: The Effect of Velocity on Cavitation Damage—Part 1

IIa MONDAY, DECEMBER 2 2:30 p.m.

Jointly with Gas Turbine Power

See Gas Turbine Power II

IIb MONDAY, DECEMBER 2 2:30 p.m.

Symposium: The Effect of Velocity on Cavitation Damage—Part 2

III MONDAY, DECEMBER 2 8:00 p.m.

Jointly with Instruments and Regulators

See Instruments and Regulators III

IVa TUESDAY, DECEMBER 3 9:30 a.m.

Compressors

A Contribution to the Design of Mixed Flow Compressors, by *H. P. Eichenberger*, Thompson Products, Inc. (Paper No. 57—A-61)

The Art of Designing Compressor Foundations, by *W. F. Swiger*, Stone & Webster Engineering Corp. (Paper No. 57—A-67)

IVb TUESDAY, DECEMBER 3 9:30 a.m.

Cavitation

Index of Cavitation Erosion by Radioisotopes, by *S. L. Kerr*, S. Logan Kerr & Co., Inc., and *Kjell Rosenberg*, A/S Hafslund, Sarpsborg, Norway (Paper No. 57—A-64)

Cavitation and Nuclei, by *R. T. Knapp*, Calif. Inst of Tech (Paper No. 57—A-80)

Study of Damaging Effects of Cavitation Erosion to Ships' Underwater Structures, by *J. Z. Lichtman, D. H. Kallas, C. K. Chatten,* and *E. P. Cochran,* New York Naval Shipyard (Paper No. 57—A-156)

V TUESDAY, DECEMBER 3 2:30 p.m.

Hydraulic Prime Movers

"DeCew Falls, Abitibi" Turbine Tests, by *A. E. Aeberli* and *R. A. Walker,* Hydro-Electric Power Commission of Ontario, Toronto, Canada (Paper No. 57—A-57)

Port Randall Turbine Modifications—Model and Field Tests[1]

Report on 1956 Field-Laboratory Testing Symposium, by *G. D. Johnson,* S. Morgan Smith Co. (Paper No. 57—A-124)

D TUESDAY, DECEMBER 3 6:30 p.m.

1982 Old Timers' Dinner

Address by: *Robert T. Knapp,* professor, California Institute of Technology, Pasadena, Calif.

VI WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with ASCE

Symposium: Welded Spiral Cases From the Consulting Engineers' and the Users' Viewpoint (Paper No. 57—A-106)

Part 1—**Hydraulic and Weight Features of Welded Spiral Casings,** by *R. A. Sutherland,* Ebasco Services, Inc.

Part 2—**Welded Scroll Case Construction,** by *G. R. Latham,* Ebasco Services, Inc.

Part 3—**Welded Spiral Cases From the Consulting Engineers' and Users' Viewpoint—TVA Experience,** by *R. M. Gardner,* Tennessee Valley Authority

Part 4—**Pressure Embedment of Spiral Cases,** by *B. G. Seitz,* U. S. Bureau of Reclamation

VIIa WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with ASCE

Symposium: Welded Spiral Cases

VIIb WEDNESDAY, DECEMBER 4 2:30 p.m.

Pumping Machinery

Prediction of Flashing Water Flow Through Fine Annular Clearances, by *Alexander Agostinelli* and *Victor Salemann,* Worthington Corp. (Paper No. 57—A-78)

Flow Characteristics of a Multiple-Cell Pump Basin, by *W. L. Dornaus,* Borg-Warner Corp. (Paper No. 57—A-59)

VIII THURSDAY, DECEMBER 5 9:30 a.m.

Fluid Mechanics

A Theory of Lubrication in Short Journal Bearings With Turbulent Flow, by *L. N. Tao,* Ill. Inst. of Tech. (Paper No. 57—A-68)

The Boundary Layer on the End Wall of a Turbine Nozzle Cascade,[1] by *Y. Senoo,* Kyushu University, Fukuoka, Japan; and *R. C. Dean, Jr.,* Intersoll Rand Corp. (Paper No. 57—A-17)

IX THURSDAY, DECEMBER 5 2:30 p.m.

Fluid Mechanics

The Effect of Wakes on the Transient Pressure and Velocity Distributions in Turbomachines, by *R. X. Meyer,* Ramo-Wooldridge Corp. (Paper No. 57—A-83)

Three-Dimensional Laminar Boundary Layer in Curved Channels With Acceleration,[1] by *Y. Senoo,* Kyushu University, Fukuoka, Japan; and *J. R. Turner,* Ingersoll-Rand Corp. (Paper No. 57—A-173)

Possible Similarity Solutions of the Laminar Incompressible Boundary Layer Equations, by *A. G. Hansen,* NACA, Lewis Flight Propulsion Lab (Paper No. 57—A-79)

X FRIDAY, DECEMBER 6 9:30 a.m.

Water Hammer

One-Way Surge Tanks for Pumping Plants, by *John Parmakian,* U. S. Bu of Reclamation (Paper No. 57—A-25)

Contributions to the Stability Theory of Systems of Surge Tanks, by *C. Jaeger,* English Electric Co., Ltd., Rugby, England (Paper No. 57—A-65)

Water Hammer in Nonuniform Pipes as an Example of Wave Propagation in Gradually Varying Media, by *H. M. Paynter* and *F. D. Ezekiel,* M.I.T. (Paper No. 57—A-107)

INSTRUMENTS AND REGULATORS SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Jointly with Aviation

See Aviation Ib

II MONDAY, DECEMBER 2 2:30 p.m.

Survey of Mathematical Methods for Nonlinear Control Systems, by *J. M. Loeb,* Schlumberger Well Surveying Co., Paris, France (Paper No. 57—A-104)

Development of the Generalized Phase Diagram Method[1]

On-Off Control With Periodic Sensing Device[1]

III MONDAY, DECEMBER 2 8:00 p.m.

Steady-State Axial Flow Forces on Pneumatic Spool-Type Control Valves, by *T. Y. Feng,* Minneapolis-Honeywell Regulator Co. (Paper No. 57—A-129)

Single-Vane, Hydraulic Servomotors and a Hydraulic Damper[1]

A New Hydraulic Servo Valve for Pulse Length Modulation Operation, by *J. E. Gibson* and *F. B. Tuteur,* Yale U, and *T. J. Mapes,* Eastern Industries, Inc. (Paper No. 57—A-128)

IV TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Hydraulic

Interpreting Dynamic Measurements of Physical Systems—Parts 1 and 2, by *S. Lees,* M.I.T. (Paper No. 57—A-103)

Reproducibility of a Pen-and-Chart Type of Recording Instrument Under Dynamic Conditions[1]

A New Type of Hot Element Directional Anemometer[1]

V THURSDAY, DECEMBER 5 2:30 p.m.

Jointly with Nuclear Engineering and Power

See Nuclear Engineering VI

JUNIOR SESSION

I TUESDAY, DECEMBER 3 8:00 p.m.

Panel Discussion: What Can the Young Engineer Do to Develop Professionally?

Ralph W. Miller, Miller, Schuerholtz & Gipe

E. C. Bailey, Commonwealth Edison Co.

E. L. Yates, General Motors Corp.

LUBRICATION SESSIONS

I TUESDAY, DECEMBER 3 8:00 p.m.

Pressure Viscosity Effects on Machine Elements

Pressure Viscosity Effect: Background[1]

Viscosity-Pressure Effect on Friction and Temperature in a Journal Bearing, by *S. J. Needs,* Kingsbury Machine Works, Inc. (Paper No. 57—A-66)

Experiments on Imperfect Lubrication, by *M. D. Hersey,* Brown U, and *C. W. Staples,* Socony Mobil Oil Co. (Paper No. 57—A-62)

Influence of Pressure and Temperature on Oil-Film Viscosity in Thrust Bearings[1]

Research Proposal on Pressure-Viscosity Effects on Machine Elements[1]

At these sessions, papers originally presented at the IMechE Conference on Lubrication and Wear, London, England, Oct. 1-3, 1957; will be presented by a reporter.

II WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Oil and Gas Power

See Oil and Gas Power II

III WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Nuclear Engineering

Frontiers in Lubrication—Nuclear and High-Temperature Environment

The Effect of Nuclear Radiation on the Properties of Lubricants,[1] by *V. W. David* and *R. Irving,* Thornton Research Center, England

Friction and Lubrication Studies at Temperatures to 1000 F,[1] by *E. E. Bisson, R. L. Johnson,* and *W. J. Anderson,* NACA, Lewis Flight Propulsion Lab (Paper No. 57—Lub-1)

Liquid Sodium as a Lubricant,[1] by *R. B. Campbell,* MERL

IV THURSDAY, DECEMBER 5 9:30 a.m.

V THURSDAY, DECEMBER 5 2:30 p.m.

VI THURSDAY, DECEMBER 5 8:00 p.m.

VII FRIDAY, DECEMBER 6 9:30 a.m.

VIII FRIDAY, DECEMBER 6 2:30 p.m.

MACHINE DESIGN SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

A New Method for Producing Continuously Adjustable Gear Ratios, by *V. W. Bolie,* Iowa State College (Paper No. 57—A-146)

Analysis of Hindley-Worm Drive, by *I. Yoshimoto,* Tokyo, Japan[1]

Spiroid Gearing, by *W. D. Nelson,* Illinois Tool Works (Paper No. 57—A-162)

II MONDAY, DECEMBER 2 2:30 p.m.

The Spring Back of Coil Springs, and Tables of Arbor Diameters Required to Produce Certain Outside Diameters of Springs, by *F. J. Gardiner,* I-T-E Circuit Breaker Co., and *H. C. R. Carlson,* The Carlson Co. (Paper No. 57—A-75)

Dynamic Characteristics of Cam Forms Calculated by the Digital Computer, by *Samuel Mercer, Jr.,* Michigan State U, and *A. R. Holowenko,* Purdue U (Paper No. 57—A-42)

Three-Dimensional Photoelasticity and Its Application in Machine Design, by *A. M. Wahl* and *M. M. Leven,* Westinghouse Research Labs (Paper No. 57—A-87)

III MONDAY, DECEMBER 2 8:00 p.m.

Jointly with Education and Management

Can a Potential Machine Designer Be Picked From Several Possibilities? by *J. F. Downie Smith,* Iowa State College (Paper No. 57—A-181)

Developing Creativity in Engineering, by *D. G. Taylor,* Minneapolis-Honeywell Regulator Co. and *R. C. Jordan,* University of Minnesota (Paper No. 57—A-182)

Human Factors Responsibilities of Design Engineers, by *J. L. Seminara,* Picatinny Arsenal, and *G. A. Peters,* Los Angeles, Calif. (Paper No. 57—A-167

IVa TUESDAY, DECEMBER 3 9:30 a.m.

Product Development—From Research to Production, Part 1—Research Cracks the Taste Barrier, by *A. M. Rockwood,* Battelle Memorial Inst (Paper No. 57—A-147)

Product Development—From Research to Production, Part 2—The Teamaker—From Prototype to Production, by *V. K. Viitanen,* Food Machinery & Chemical Corp. (Paper No. 57—A-145)

The Effect of Fretting on the Fatigue Characteristics of Titanium-Steel and Steel-Steel Joints, by *W. L. Starkey, S. M. Marco,* and *J. A. Collins,* Ohio State U (Paper No. 57—A-113)

IVb TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Management

See Management II

V TUESDAY, DECEMBER 3 2:30 p.m.

Measuring the Preload of Ball or Roller Bearings, by *C. L. Emmerich,* Norden-Ketay Corp. (Paper No. 57—A-43)

Second-Acceleration Analyses of Plane Mechanisms, by *J. C. Wolford,* U of Nebraska, and *Allen S. Hall, Jr.,* Purdue U (Paper No. 57—A-52)

An Indirect Method for Determining Accelerations in Complex Mechanisms, by *T. P. Goodman* M.I.T. (Paper No. 57—A-108)

VI TUESDAY, DECEMBER 3 8:00 p.m.

Jointly with Management

Relationship Between Engineering and Research in a Medium-Sized Multiproduct Company[1]

Product Development and Engineering Coordination for Accomplishment in a Medium-Sized Company[1]

Meeting the Engineering-Research and Development Needs of a Medium-Sized Company, by *K. R. Herman,* Vickers, Inc. (Paper No. 57—A-161)

VII WEDNESDAY, DECEMBER 4 9:30 a.m.

The Sprag-Type Over-Running Clutch, by *R. L. Daniels,* Formsprag Co.[1]

Application of Sprag-Type Over-Running Clutches,[1] by *W. T. Cherry,* Formsprag Co.

Precision Spring Over-Running Clutches[1]

VIII WEDNESDAY, DECEMBER 4 2:30 p.m.

Numerical Control Impact on Machine Design[1]

An Automatic Single-Fiber Tensile-Strength Tester, by *P. C. Wharff, Jr.,* and *R. A. Crane,* The Dow Chemical Co. (Paper No. 57—A-158)

Design of a Tape Reader for Numerically Controlled Positioning Machines[1]

MAINTENANCE SESSION

I FRIDAY, DECEMBER 6 9:30 a.m.

Planning and Scheduling for Effective Maintenance Cost Control[1]

Maintenance Cost Control[1]

Improved Lubrication[1]

MANAGEMENT SESSIONS

I MONDAY, DECEMBER 2 8:00 p.m.

Jointly with Machine Design and Education

See Machine Design III

II TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Machine Design

Human Factors in Engineering

Human Factors in Engineering Design, by *Renato Contini,* NYU (Paper No. 57—A-56)

Vehicle Vibration—Man's New Environment, by *A. O. Radke,* Bostrom Research Labs (Paper No. 57—A-54)

Physiological Evaluation of Human Effort in Industry, by *Lucien Brouha,* E. I. du Pont de Nemours & Co., Inc. (Paper No. 57—A-55)

Human Factors Engineering—Working Program[1]

L TUESDAY, DECEMBER 3 12:15 p.m.

Management Luncheon

III TUESDAY, DECEMBER 3 2:30 p.m.

The Job of the Specialist in Management[1]

Management, Engineering, and Architecture—Their Changing Roles in the Age of Automation[1]

IV TUESDAY, DECEMBER 3 8:00 p.m.

Jointly with Machine Design

See Machine Design VI

V THURSDAY, DECEMBER 5 8:00 p.m.

Jointly with Production Engineering

See Production Engineering III

VI FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Production Engineering

See Production Engineering IV

MATERIALS HANDLING SESSIONS

Ia *Jointly with Aviation—SAE*

See Aviation Ia

Ib MONDAY, DECEMBER 2 9:30 a.m.

Work Sampling Applied to Material Handling, by *W. J. Richardson,* Lehigh U (Paper No. 57—A-96)

Material-Handling Analysis by Travel Charts[1]

II MONDAY, DECEMBER 2 2:30 p.m.

Automation—Aspirations and Achievements[1]

Analysis of Citrus Bulk Handling Costs Through the Packing House, by *R. V. Phillips,* Haines City Citrus Growers Association, and *W. Grierson,* U of Florida (Paper No. 57—A-101)

Pinning Down the Costs of Materials Handling[1]

III TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Aviation

See Aviation III

IV WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Rubber and Plastics and Railroad

See Rubber and Plastics I

MEMBERS AND STUDENTS LUNCHEON

L WEDNESDAY, DECEMBER 4 12:15 p.m.

METALS ENGINEERING SESSIONS

I MONDAY, DECEMBER 2 8:00 p.m.

Jointly with Power

See Power III

II TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Nuclear Engineering

See Nuclear Engineering II

III TUESDAY, DECEMBER 3 8:00 p.m.

Jointly with Effect of Temperature on Metals

See Effect of Temperature on Metals

IV FRIDAY, DECEMBER 6 9:30 a.m.

Creep-Rupture Data—Testing and Interpretation

Uniaxial Stress at Constant Temperature[1]

Cyclic Stress and Temperature[1]

Combined Stress[1]

Theories of Creep[1]

Stress Analysis[1]

Failure Criteria[1]

Ductility Requirements[1]

Factors of Safety[1]

V FRIDAY, DECEMBER 6 2:30 p.m.

Service Life

Simulated Service Tests—Comparison With Laboratory Tests[1]

Residual Life of a Structure After a Given Service[1]

Correlation of Service Experience With Design Practice[1]

METAL PROCESSING SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

A Method for Studying the Behavior of Cutting Fluids in Wear of Tool Materials, by *L. V. Colwell,* U of Michigan (Paper No. 57—A-160)

The Spiral Point Drill—A New Concept in Drill Point Geometry, by *Hans Ernst* and *W. A. Haggerty,* Cincinnati Milling Machine Co. (Paper No. 57—A-98)

II MONDAY, DECEMBER 2 2:30 p.m.

Behavior of Cutting Fluids in Reaming Steels, by *L. V. Colwell* and *Henrik Branders,* U of Michigan (Paper No. 57—A-168)

Machinability of High Strength Cast Irons[1]

On the Economics of the Basic Turning Operation,[2] by *R. C. Brewer,* Royal Technical College, Lancaster, England (Paper No. 57—A-58)

Productive Research in Metal Cutting,[2] by *M. E. Merchant,* Cincinnati Milling Machine Co. (Paper No. 57—A-99)

III MONDAY, DECEMBER 2 8:00 p.m.

Stresses Alter Hardness, by *S. K. Setty, J. T. Lapsley,* and *E. G. Thomsen,* U of California (Paper No. 57—A-77)

The Chatter of Lathe Tools Under Orthogonal Cutting Conditions, by *S. A. Tobias* and *W. Fishwick,* U of Cambridge, Cambridge, England

The Effect of Tool-Chip Contact Area in Metal Machining,[2] by *Hidehiko Takeyama* and *E. Usui,* The Government Mechanical Lab, Tokyo, Japan (Paper No. 57—A-45)

NUCLEAR ENGINEERING SESSIONS

I TUESDAY, DECEMBER 3 9:30 a.m.

Jointly with Gas Turbine Power

See Gas Turbine Power III

L TUESDAY, DECEMBER 3 12:15 p.m.

Nuclear Engineering Luncheon

Jointly with Fuels

II TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Metals Engineering

Materials and Fabrication in Nuclear Power

Metallurgical Design and Fabrication Problems in Vessels for Nuclear Power[1]

Design Properties of Silver-Indium-Cadmium Alloy Rods for Pressurized Water Reactors[1]

The Effect of Grain Size on Ultrasonic Attenuation in Forged Steels[1]

III WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Heat Transfer

See Heat Transfer VI

IV WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Lubrication

See Lubrication III

V THURSDAY, DECEMBER 5 9:30 a.m.

Jointly with Power

See Power IX

VI THURSDAY, DECEMBER 5 2:30 p.m.

Jointly with Power and Instrument and Regulators

Nuclear Steam-Power Plant Components[1]

Operating Experiences and Their Effect on Component Design[1]

Considerations in the Instrumentation of Boiling-Water and High-Temperature Sodium Reactors

Steady-State Thermal Design of Pressurized Light-Water Cooled and Moderated Nuclear Reactor Cores[1]

Air-Operated Reactor Safety Rods[1]

D THURSDAY, DECEMBER 5 6:30 p.m.

Nuclear Engineering Dinner

Address by: *Theodore Baumeister,* professor of Mechanical Engineering, Columbia U, New York, N. Y.; General Public Utilities Corp., New York.

Address by: *Francis K. McCune,* vice-president and manager, Atomic Power Division, General Electric Co., Schenectady, N. Y.

VII FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Applied Mechanics

Thermal and Dynamic Stress Analysis in Nuclear Design

Effect of Viscous Damping on Step Velocity Shock of a Two-Mass System[1]

Vibration of Rods Induced by Water in Parallel Flow, by *D. Burgreen, J. J. Byrnes,* and *D. M. Baenfrado,* Nuclear Development Corp. of America (Paper No. 57—A-94)

Axial Temperature Gradient Bending Stresses in Thin Walled Tubes Adjoining a Heavy Section, by *F. G. Hammitt*, U of Michigan (Paper 57—A-13)

Stresses in Long Thick Walled Cylinders Caused by Pressure and Temperature[1]

The Dependence of Thermal Stresses in Cylindrical Reactor Fuel Elements Upon the Method of Cooling, by *K. R. Merckx*, General Electric Co. (Paper No. 57—A-136)

OIL AND GAS POWER

SESSIONS

I TUESDAY, DECEMBER 3 2:30 p.m.

Pressure Fluctuations in Multicylinder Exhaust Manifolds[1]

A Super Charge System for Compression, Pilot, and Spark-Ignition Engines[1]

II WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Lubrication

These papers will be presented by a reporter

Laboratory Investigations on the Action of Detergent Additives in Lubricating Oils, by *J. T. Davies*, Cambridge U, Cambridge, England

The Control of Wear in Piston Engines, by *J. A. Edgar*, Shell Oil Co.

How the Crankcase Lubricating Oils of Internal-Combustion Engines Alter During Use, by *J. B. Mathews*, Thornton Research Labs, England

The Importance of Surface Finish, Loaded Area Conformity and Operating Temperature in Small End Plain Bearings, for High-Duty Two-Stroke Engines, by *E. A. Blount* and *D. DeGuerin*, D. Napier & Son, Ltd., London, England

Factors Influencing the Rate and Distribution of Bearing and Journal Wear in Automobile Engines, by *D. W. C. Baker* and *E. D. Brailey*, Glacier Metals, England

Lubrication of Road-Vehicle Engines and Worn-Driven Axles With Reference to Vehicle-Fuel Consumption, by *A. T. Wilford*, England

Some Problems in the Lubrication of Small Two-Stroke Petrol Engines, by *A. Towle*, England

Methods of Testing Filter Performance and Characteristics of Some Types of Filters, by *E. A. Stokes* and *G. H. Vokes*, Vokes, Ltd., Surrey, England

PETROLEUM

SESSIONS

I TUESDAY, DECEMBER 3 9:30 a.m.

Application of Safety Relief Valves to Pipe Lines[1]

Design of Floating Heads for Heat Exchangers[1]

Steam and Electric Systems for Oil Refineries[1]

L TUESDAY, DECEMBER 3 12:15 p.m.

Petroleum Luncheon

Presider: *H. H. Meredith, Jr.*, division engineer, Humble Oil & Refining Co., Tyler, Texas

Address by: *Ronald B. Smith*, vice president, The M. W. Kellogg Co., New York, N. Y.

POWER

SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Progress of the Development of Turbine-Generator Rotor Materials[1]

Experimental and Analytical Study of Ultrasonic Testing of Large Rotor Forgings[1]

A Program for the Appraisal of the Tendency of Brittle Fracture in Steel Forgings[1]

II MONDAY, DECEMBER 2 2:30 p.m.

Application of the Griffith-Irwin Theory of Crack Propagation to the Bursting Behavior of Rotors[1] **Including Analytical and Experimental Studies**

The Propagation of Cracks and Energy of Elastic Deformation[1]

Overspeed Problems of Reheat Tandem Turbine Generator Units[1]

III MONDAY, DECEMBER 2 8:00 p.m.

Jointly with Metals Engineering

Croloy 15-15-N—An Austenitic Heat-Resistant Alloy for Severe Tubular Applications at Elevated Temperatures[1]

The High-Temperature Properties of 18-12-1 Cr-Ni-Nb-Steel—A Summary of British Data[1]

Creep, Stress-Relaxation, and Metallurgical Properties of Steels for Steam-Power Plants Operating Above 950 F[1]

IV TUESDAY, DECEMBER 3 9:30 a.m.

Analysis of the Steam-Turbine Reheat Cycle[1]

Continuous Monitoring Equipment for Power-Plant Cycles, by *A. J. Hornfeck, T. S. Imsland*, and *R. F. Janofsky*, Bailey Meter Co. (Paper No. 57—A-176)

Thermo-Dynamic Efficiency of the Field Cycle, by *J. H. Horlock*, M.I.T. (Paper No. 57—A-44)

Va TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Boiler Feedwater Studies

See Boiler Feedwater Studies II

Vb TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Fuels

See Fuels IV

VI TUESDAY, DECEMBER 3 8:00 p.m.

Economic Choice of Generator Unit Size, by *A. G. Mellor* and *L. K. Kirchmayer*, Gen. Elec. Co. (Paper No. 57—A-154)

Development of High-Pressure Pumps for Controlled Circulation and Supercritical Steam Generators

VII WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Boiler Feedwater Studies

Treatment of Make-Up Feedwater, Condensate, and Recycle Water for Supercritical and Nuclear Reactor Power Plant Cycles[1]

Observed Effects of Deposits on Steam-Turbine Efficiency, by *K. C. Cotton* and *J. Angelo*, Gen. Elec. Co. (Paper No. 57—A-116)

The Development of an Experimental Laboratory for Performance Tests of Steam-Turbine Blading, by *F. J. Enright*, Allis-Chalmers Manufacturing Co. (Paper No. 57—A-163)

VIIIa WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Heat Transfer

See Heat Transfer VII

VIIIb WEDNESDAY, DECEMBER 4 2:30 p.m.

Jointly with Fuels

Some Uses of Still Photography in Engineering, by *W. C. Foulke*, Eastman Kodak Co. (Paper No. 57—A-155)

Machine Welding of Piping and Some Probable Causes of Failure[1]

Should Ultrasonic Inspection Be Used to Augment Radiography in the Inspection of Weldments in High-Pressure Piping[1]

First Steps With a Digital Computer, by *R. H. Gherst*, United Engineers and Constructors, Inc. (Paper No. 57—A-164)

IX THURSDAY, DECEMBER 5 9:30 a.m.

Jointly with Nuclear Engineering

Problems With Reactors for Power Production

Why Low-Pressure Steam From Nuclear Reactors?[1]

Investigation of Erosion and Corrosion of Turbine Materials in Wet Oxygenated Steam, by *C. F. Cheng, H. A. Cataldi*, and *V. S. Musick*, Gen. Elec. Co. (Paper No. 57—A-134)

Safety Features of Power Reactors

High-Temperature Gas-Cooled Power Reactor[1]

Xa THURSDAY, DECEMBER 5 2:30 p.m.

Computer Applications in Nonnuclear Aspects of Ship Design, by *W. M. Heltsel*, Newport News Shipbldg. & Drydock Co. (Paper No. 57—A-117)

Performance Tests of a Vertical Steam Generator for Nuclear Power Plants, by *C. C. Peake* and *R. L. Coit*, Westinghouse Elec. Corp. (Paper No. 57—A-141)

Electrolytic Tank Analog for Studying Fluid-Flow Fields Within Turbomachinery, by *R. P. Benedict* and *C. A. Meyer*, Westinghouse Elec. Corp. (Paper 57—A-120)

Xb THURSDAY, DECEMBER 5 2:30 p.m.

Jointly with Power Test Codes and Fluid Meters

See Power Test Codes

Xc THURSDAY, DECEMBER 5 2:30 p.m.

Jointly with Nuclear Engineering and Instruments and Regulators

See Nuclear Engineering VI

XI THURSDAY, DECEMBER 5 8:00 p.m.

Jointly with Properties of Steam

A Steam-Properties Program for Medium and Large Computers[1]

Formulations for the Thermodynamic Properties of Steam and Water, by *H. C. Schnackle*, Gen. Elec. Co. (Paper 57—A-105)

The Formulation of Steam Properties for Digital Computer Applications, by *W. G. Steltz* and *G. J. Silvestri*, Westinghouse Elec. Corp. (Paper No. 57—A-109)

Interpolated Tables—Enthalpy Superheated Steam[1]

XII FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Properties of Steam

See Properties of Steam II

POWER TEST CODES

SESSIONS

I THURSDAY, DECEMBER 5 2:30 p.m.

Jointly with Power and Fluid Meters

Temperature Measurement[1]

A Condensate Flow Measuring Section for Steam-Turbine Performance Testing[1]

Problems in Measuring Steam Flow at 1250 Psia and 950 F With Nozzles and Orifices, by *John Goldsbury*, Gen. Elec. Co., and *J. W. Murdock*, U. S. Naval Boiler and Turbine Lab (Paper No. 57—A-88)

D THURSDAY, DECEMBER 5 6:00 p.m.

Power Test Codes Dinner

PRESIDENT'S LUNCHEON

PL MONDAY, DECEMBER 2 12:15 p.m.

Address by: *William F. Ryan*, ASME President

PROCESS INDUSTRIES

SESSIONS

I TUESDAY, DECEMBER 3 8:00 p.m.

Jointly with Heat Transfer

The Third Law[1]

Temperature Distribution in Fins and Other Projections, Including Those of Building Structures, by Several Procedures, by *C. F. Kayan* and *R. G. Gates*, Columbia U (Paper No. 57—A-177)

II WEDNESDAY, DECEMBER 4 9:30 a.m.

Design by Logic—Automatic Chemical Batching, by *J. P. Laird*, E. I. du Pont de Nemours & Co., Inc. (Paper No. 57—A-151)

Product and Process Improvement Through Statistical Engineering[1]

III WEDNESDAY, DECEMBER 4 2:30 p.m.

Continuous Pump Control by a Dual Pneumatic Circuit, by *E. R. Forman* and *W. R. Jensen*, Moore Products Co. (Paper No. 57—A-53)

Innovations in Refuse-Incinerator Design[1]

PRODUCTION ENGINEERING

SESSIONS

I THURSDAY, DECEMBER 5 9:30 a.m.

Cold Roll Forming—A Chipless Production Process[1]

Compressive Working of Metals—A Chipless Production Process[1]

II THURSDAY, DECEMBER 5 2:30 p.m.

Production and Use of Perlitic Malleable Castings[1]

Steps Taken by One Medium-Size Foundry to Meet Today's Competition[1]

III THURSDAY, DECEMBER 5 8:00 p.m.

Jointly with Management

Storage Problems Within and Surrounding a Partially Automated Integrated Line[1]

A Method of Determining the Economics of Automation[1]

IV FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Management

Production Stabilization Problems in Photographic Processing, by *J. M. Alliderige,* Eastman Kodak Co., *Paul Caris,* Palo Alto Processing Lab, and *W. H. Michie,* Eastman Kodak Co. (Paper No. 57—A-131)

Storage and Banking Techniques in an Integrated Process[1]

V FRIDAY, DECEMBER 6 2:30 p.m.

Development of Center Drive Lathes[1]

Application of Center Drive Lathes[1]

PROPERTIES OF STEAM

SESSIONS

I THURSDAY, DECEMBER 5 8:00 p.m.

Jointly with Power

See Power XI

II FRIDAY, DECEMBER 6 9:30 a.m.

Jointly with Power

Apparatus for the Experimental Study of the Thermodynamic Properties of Water[1]

Oscillating-Disk Viscometer for Measurements on Steam[1]

Study of P-V-T Data on Steam[1]

A Note on Pseudotransition Locus for Water in the Supercritical Region[1]

III FRIDAY, DECEMBER 6 2:30 p.m.

Equipment for the Study of the Viscosity of Steam[1]

Thermal Diffusivity of Gases as Determined by the Cyclic Heat-Transfer Method[1]

Acoustic Properties of Steam[1]

RAILROAD

SESSIONS

I WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Rubber and Plastics and Materials Handling

See Rubber and Plastics I

II WEDNESDAY, DECEMBER 4 2:30 p.m.

Progress in Railway Mechanical Engineering, 1956-1957[1]

Notes on the Starting of Trains, by *S. Kyropoulos,* Holloman Air Development Center (Paper No. 57—A-148)

Advancing Adhesion, by *F. G. Fisher,* The Reading Co., *R. K. Allen,* Gen. Elec. Co., and *G. W. Luvisi,* National Aluminate Corp. (Paper No. 57—A-130)

Improving Rail Adhesion for Diesel Locomotives[1]

III THURSDAY, DECEMBER 5 9:30 a.m.

Mechanical Refrigeration in Railroad Refrigerator Cars, by *B. E. Duff,* Fruit Growers Express Co. (Paper No. 57—A-114)

Testing of Railway Passenger Cars and Components, by *W. W. Seary, Jr.,* The Budd Co. (Paper No. 57—A-111)

Some Factors Affecting the Riding Comfort of Passenger Cars, by *W. E. Burdick,* Gen. Steel Castings Corp. (Paper No. 57—A-153)

IV THURSDAY, DECEMBER 5 2:30 p.m.

Should Purchasing Be a Matter of Material and Construction Specification or Functional Specification[1]

Design of an 8500-Hp Gas Turbine-Electric Locomotive for High-Speed Freight Service, by *F. D. Gowans,* Gen. Elec. Co. (Paper No. 57—A-149)

A Proposed Coal-Burning Gas-Turbine Locomotive[1]

RUBBER AND PLASTICS

SESSIONS

I WEDNESDAY, DECEMBER 4 9:30 a.m.

Jointly with Railroad and Materials Handling

Designing Belts for Material Handling, by *F. W. Blanchard,* Hewitt-Robins, Inc. (Paper No. 57—A-170)

The Development of a Passenger Belt-Conveyer System, by *Paul W. Freitag, Jr.,* Goodyear Tire & Rubber Co. (Paper No. 57-A-178)

The Development of Airsprings and Their Application to Automotive, Aircraft, and Industiral Uses, by *H. H. Deist,* Firestone Tire & Rubber Co. (Paper No. 57—A-179)

Rubber for Pivots in Heavy-Duty Vehicles[1]

II WEDNESDAY, DECEMBER 4 2:30 p.m.

Tensile Behavior of Reinforced Plastic Laminations and Composite Plates

Prediction of Creep in Bending From Tension and Compression Creep Data When Creep Coefficients Are Unequal[1]

The Initiation of Necking and Its Effect on the Tensile Behavior of Polyethylene[1]

III THURSDAY, DECEMBER 5 9:30 a.m.

Design and Evaluation of the Plastic House of the Future[1]

3M Brand Fluoro-Rubber $1F_4$[1]

"Teflon" 100X Perfluorocarbon Resin Properties and Applications[1]

IV THURSDAY, DECEMBER 5 2:30 p.m.

A High Shear Rate Capillary Rheometer for Polymer Melts[1]

Polymer Gear Pumps[1]

Review of Developments in Plastics Engineering, 1956-1957[1]

Summary of Papers Presented at the Rubber and Plastics Session

SAFETY

SESSIONS

I MONDAY, DECEMBER 2 9:30 a.m.

Planning Safety Into Automation[1]

The Safe Use of Isotopes in Industry, by *William A. Brobst,* U. S. Atomic Energy Commission (Paper No. 57—A-180)

II TUESDAY, DECEMBER 3 2:30 p.m.

Jointly with Aviation

See Aviation IVa

SOLAR ENERGY

SESSION

I TUESDAY, DECEMBER 3 8:00 p.m.

Plastic Materials and Their Uses in the Field of Solar Energy[1]

Engineering Research With a Solar Furnace[1]

Intermittent Absorption Cooling Systems (With Solar Regeneration)[1]

TEA

DANCE

T MONDAY, DECEMBER 2 4:00 p.m.

TEXTILE ENGINEERING

SESSIONS

I THURSDAY, DECEMBER 5 9:30 a.m.

Ten Years of Spinning-Frame Progress[1]

Spinning Yarn Directly From Silver[1]

Spinning of Tomorrow[1]

L THURSDAY, DECEMBER 5 12:15 p.m.

Textile Engineering Luncheon

Presider: *H. W. Ball,* Foster Machine Co., Westfield, Mass.

Speaker: *John P. Baum,* vice-president, Woolen & Worsted Division, J. P. Stevens & Co., Inc., North Andover, Mass.

Subject: **Engineering in the Textile Industry**

II THURSDAY, DECEMBER 5 2:30 p.m.

Textile Spindles and Their Lubrication[1]

Adequate Electrical Equipment in Textile Mills[1]

WOOD INDUSTRIES

SESSIONS

I THURSDAY, DECEMBER 5 9:30 a.m.

Mechanization and Automation of Small Sawmills, by *F. C. Simmons,* Northeastern Forest Experiment Station (Paper No. 57—A-48)

Research in Sawmilling[1]

L THURSDAY, DECEMBER 5 12:15 p.m.

Wood Industries Luncheon

Presider: *L. A. Patronsky,* Chairman, ASME Wood Industries Division, Northwest Timber Co., Coeur D'Alene, Idaho

Speaker: *L. J. Markwardt,* assistant director, U. S. Forest Products Laboratory, Madison, Wis.

Subject: **The Continuous Yield of Our Forests**

II THURSDAY, DECEMBER 5 2:30 p.m.

The Automatic Lumber Planing Mill, by *Peter Koch,* Champlin Box Co. (Paper No. 57—A-16)

Steel Strapping of Lumber-Veneer and Other Wood Prod., by *E. P. Naumes,* Acme Steel Co.

ROY V. WRIGHT

LECTURE

WL TUESDAY, DECEMBER 3 5:00 p.m.

Introduction: *The Hon. Ralph E. Flanders,* United States Senator from Vermont, past president and Hon. Mem. ASME

Speaker: *The Hon. Joseph B. Johnson,* Governor of the State of Vermont

Subject: **Engineers and Scientists in Civic, Public, and Political Life**

WOMEN'S

PROGRAM

SUNDAY, DECEMBER 1

2:00 p.m. Registration
5:00 p.m. "Early Bird" Party

MONDAY, DECEMBER 2

8:30 a.m. Registration
9:00 a.m. Coffee Hour
12:00 noon President's Luncheon
4:00 p.m. Tea Dance
7:00 p.m. Night Club Tour

TUESDAY, DECEMBER 3

8:30 a.m. Registration
8:30 a.m. National Board Breakfast and Meeting
9:00 a.m. Coffee Hour
10:15 a.m. Tour of New York City
12:30 p.m. Brunch at Helena Rubinstein's Penthouse Apartment
4:00 p.m. Auxiliary Workshop
8:00 p.m. Hawaiian Night

WEDNESDAY, DECEMBER 4

10:00 a.m. Auxiliary Annual Meeting
12:30 p.m. Annual Luncheon and Fashion Show, Park Lane Hotel
7:00 p.m. Banquet

THURSDAY, DECEMBER 5

8:30 a.m. Rachel Kent's Coffee Hour and India Program
12:00 noon Luncheon, Downtown Athletic Club, Roof Garden
1:30 p.m. Tour of the N. Y. Stock Exchange

FRIDAY, DECEMBER 6

Auxiliary Workshop

Science of HEAT TRANSFER Moves Into New Ground AT PENN STATE Conference

First ASME-AIChE Heat Transfer Conference draws 413 engineers and scientists from 154 companies. Leading manufacturers exhibit.

At Penn State University, in the mountain country of central Pennsylvania, The American Society of Mechanical Engineers and the American Institute of Chemical Engineers held a joint Conference and Exhibit, the first to be devoted entirely to heat transfer. For the four days of technical sessions, Aug. 12-15, the Conference drew 413 engineers and scientists from 154 of the country's engineering firms. Thirty-one colleges and universities were represented.

The Joint Conference took on a special dimension in being dedicated to the dean of heat-transfer engineers, Professor William H. McAdams, Mem. ASME, of M.I.T., who is retiring this year. The banquet in his honor became a moving occasion because so many of the engineers present, from all over the country, had been his pupils.

At the banquet, W. F. Ryan, President of the ASME, paid tribute to the guest who had pioneered in heat transfer. It was good, he said, to see "these experts, these leaders in the field, doing honor to the man who started them on their way."

The Widening Field

In this high-speed, high-temperature era, engineering dilemmas elevate heat transfer to a position of first importance. For the new power plants, gas-turbine designers find themselves impelled toward such expedients as internally cooled turbine blades. In nuclear reactors, heat-transfer rates must be stepped up. In supersonic aviation, heat becomes the limiting factor. Developments unheard of, before World War II, present new challenges to the men who engineer the transmission of heat.

The Conference's first paper, presented by F. L. Test, Assoc. Mem. ASME, of the University of Rhode Island, typified current progress in heat transfer, in that it represented a careful addition to the still-meager data. Professor Test spoke on "Heat Transfer and Pressure Drop Under Conditions of Laminar Flow in the Shell Side of Cross-Baffled Heat Exchangers," his experiments being aimed at investigation the low-Reynolds-number region. The first session also heard papers by V. S. Arpaci of M.I.T. (heat exchangers with internal heat sources) and R. S. Fairall of the Garrett Corporation, Los Angeles, Calif. (new method of heat-exchanger design).

Double Sessions

For its schedule of 35 technical papers, the Conference divided into two sessions, using lecture halls in both the Hetzel Building and the Osmond Laboratory. On the first afternoon, six papers were presented, by engineers from Purdue, Westinghouse, Brookhaven, Litton Industries, Carnegie Tech, and New York University. Western Union's "Teledeltos" conductive sheet appeared in the report by Fred Landis, Assoc. Mem. ASME, of NYU, who used a Teledeltos paper analog to determine the effectiveness of stub fins.

On succeeding days, high registration made it necessary to move sessions from the Hetzel Union Hall to a larger hall in the Electrical building.

The 154 firms covered an impressive range of product: Chemicals, petroleum, rubber, of course; and firms dealing directly with heat-exchange equipment. There were also companies making aircraft and aircraft engines (eight firms), instruments, steel, submarines. There were railroads and nuclear developments groups. Of the 35 colleges and universities, Penn State naturally led, with 14 registrations; M.I.T. was next, with eight, and there were five from the University of Michigan.

While most of the progress in the heat-transfer science takes the form of plodding advance over difficult terrain, there were papers that suggested break-through. One that aroused special interest and discussion was that of Hottel and Cohen, both of M.I.T., who reported on radiant heat exchange in a gas-filled enclosure. The paper, presented by Professor Cohen, set forth a method for predicting the effect of radiation exchange on temperature and heat transfer within a furnace chamber. Another was that of Novak Zuber, of UCLA, who investigated the "Stability of Boiling Heat Transfer." Nuclear reactors and rocket engines have drawn attention to boiling as a mode of transferring heat of high densities.

Other Values

The Conference had other values. Socially, it became a special sort of reunion of men who had studied together—or under the same tutors at different times—and who were making or renewing friendships among the people of their specialty.

This pleasant feature began to operate

Down front at a session in Osmond Lab. *Left to right:* M. T. Cichelli, du Pont; Myron Tribus, UCLA; Mrs. F. F. Buckland, General Electric; and Novak Zuber, UCLA.

"Hardware" on display. Exhibits by manufacturers gave the conferees opportunity to examine and discuss the products their science calls into being. On display were makes of shell-and-tube heat exchangers, and radiators for many purposes. There was a plate heat exchanger, and also one with a spiral configuration, as well as a gas-to-gas exchanger with streamlined pin fins. One display featured a glass model of a centrifugal processing unit intended for use where chemicals, foodstuffs, and pharmaceuticals must be processed through heat transfer. Altogether, there were 19 booths arranged along both walls of an exhibition area in the lower level of the Hetzel Union Building.

at the reception, Sunday evening, August 11, in a lounge of the Hetzel Building, named for the man who was President of Penn State from 1926 to 1947. Again, on Monday evening, the conferees—and their wives—had supper at the country club, and then strolled the lawns, enjoying the scenery of the Nittany Mountains. The mountains no longer harbor the big cats that symbolize the university (there is a statue of a mountain lion near the stadium), but they lend picture-postcard beauty to the Penn State campus.

Boys and Girls Together

The women came to this Conference, 40 of them, accompanying their husbands to Penn State's garden spot. There were two women engineers, both from General Electric. Vacation time made this possible for many families; children not in school could be left with grandparents. Children could also be brought to the Conference, and 19 were, ages one month to 16 years.

Chairman of the local committee was Prof. J. C. Lester, who is also the faculty adviser of the ASME Student Branch at Penn State, an active group which last year numbered 160 student members. Professor Lester's committee had prepared a program for both conferees and their families, Mrs. Lester heading the women's comittee.

While the men followed technical sessions—or gazed into the atomic reactor, or prowled the powerful water tunnel (research on naval torpedoes)—the women visited the Mineral Industries Museum and heard a lecture, with movies, on the manufacture of chinaware. Or, in outboard motorboats, they explored Penn's Cave. Or they toured State College homes, seeing the latest in modern architecture.

It would be hard to imagine how the local committee could have handled the Conference more graciously or efficiently, but the topper was the children's program, Mrs. E. P. Nye in charge. Mothers were supplied a list of approved baby sitters. Playrooms and trips were waiting for the children according to their ages and inclinations. At times, when parents had social engagements, youngsters were off to see Disney's "Bambi," or playing games, or having stories read to them.

Memorable for the youngsters was a trip to the Penn State Model Farm, where they went through the barns and saw the mechanical milking, and each child had his turn to pat a cow on the nose. One small boy reported a positive method of telling bulls from cows: "A bull always has a ring in his nose."

Banquet for Professor McAdams

At the banquet, with 400 engineers and their ladies packed into the banquet hall of the Nittany Lion Inn, both Societies joined in doing honor to Professor McAdams.

At the speaker's table with the retiring M.I.T. professor were ASME president Ryan and F. W. Miller, vice-president of ASME's Region III. Present also were C. E. Davies, secretary, ASME, and T. A. Marshall, Jr., assistant secretary.

F. J. Van Antwerpen, Secretary of the AIChE, was there to speak for his Society. Others were S. D. Kirkpatrick, of McGraw-Hill, publisher of the McAdams book, and Prof. T. B. Drew, Mem. ASME, of Columbia University, a co-worker with Professor McAdams. Toastmaster Sigmund Kopp, of Alco Products, and chairman of the ASME's Heat Transfer Division, made the introductions.

President Ryan, in his speech, called for more joint meetings of these two engineer-

Left to right: **Fred Landis of NYU; M. W. Rosenthal, Oak Ridge National Lab.; N. R. Johnson of Carnegie; N. E. Friedman, of Litton; and R. H. Norris, General Electric**

Committeemen for the ASME. *Left to right:* R. M. Persyn, Central Pennsylvania Section; G. M. Dusinberre, National Committee; and J. C. Lester, head of local group

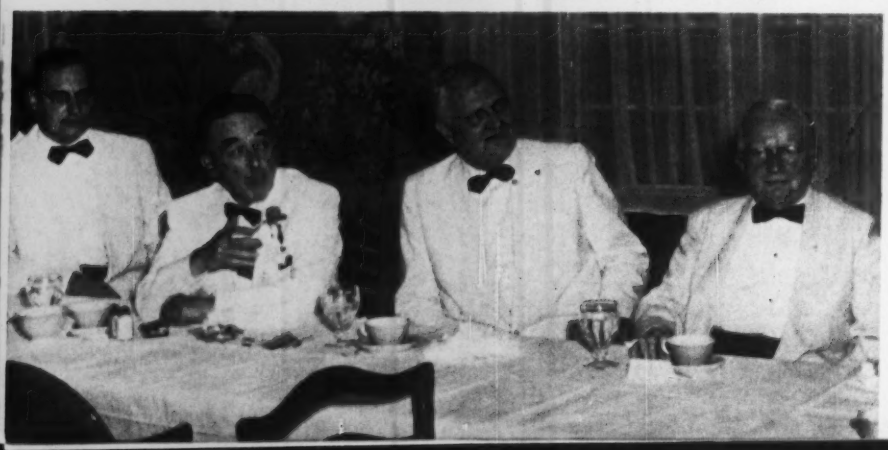
No vacancy. Banquet hall of the Nittany Lion Inn is filled to capacity as 400 heat-transfer engineers of the ASME and the AIChE gather to honor Professor McAdams

Above: Professor T. B. Drew of Columbia fills in the personal story. Facing us, *from the left,* are S. D. Kirkpatrick, Professor McAdams, and Sigmund Kopp.

Below: F. J. Van Antwerpen, AIChE secretary, speaks for co-operation. Below him, *in profile,* is Mrs. W. H. McAdams, wife of the guest of honor.

Below: S. D. Kirkpatrick of McGraw-Hill recounts his struggles with the McAdams book. *At the right:* Myron Tribus (profile), T. B. Drew, F. W. Miller.

Below, left to right: A. C. Mueller, G. M. Dusinberre, both of the National Committee; C. E. Davies, secretary ASME; and ASME President W. F. Ryan



ing societies. He liked the fact that the program had made no distinction as to the membership of the authors of technical papers. Whether a paper had been sponsored by the ASME or the AIChE was noted only in the fine print. Many authors, of course, belonged to both societies.

"In these two societies," Dr. Ryan said, "we've got the bulk of the country's heat-transfer men. At the sessions, I was impressed by the authors' thoroughness of preparation. The papers were excellent."

Dr. Ryan made his bow to the young engineers. He has many times commented on the youth of the outstanding men in the rapidly advancing sciences: The spearhead of the advance is often the engineer fresh from his MS or his doctorate, his mathematics sharp and efficient. The white-haired President welcomed the young men. "You may not feel young, but you look young to me."

He then expressed his great pleasure in taking part in an event in which the leading heat-transfer men did honor to Professor McAdams.

"There are men here," he said, "who will tell their grandsons they met him."

Mr. Van Antwerpen emphasized the joint character of the Conference, the co-operation between the societies, "now in full flood." He observed that it had its origins in the Engineers' Council for Professional Development and the En-

Banquet night finds the guest of honor, *right,* in holiday mood. So many of the engineers had been pupils of his, that the Conference partook of the spirit of a reunion. Professor McAdams took no active part in the daily technical sessions, but his presence dominated the Conference.

gineers Joint Council, through which we speak "with one voice on problems that concern us all."

Mr. Van Antwerpen found this co-operation valuable not only as a powerful assist in scientific progress, but as the only basis of trust, in world politics as in technical affairs. The time and temper has to be right. "You can't force feed co-operation. It has to come naturally."

Man in the Middle

Mr. Kirkpatrick spoke affectionately of the McAdams book, "Heat Transfer," whose publication he promoted. Over the years, Mr. Kirkpatrick has been the man in the middle, the editor caught between author and publisher, between important writing and the financial problems of publishing. Caught, also, in the controversies surrounding scientific advance.

"We needed asbestos paper," he said, "for some of the correspondence on heat transfer at the time of this book."

In 1933 they finally brought out the McAdams book. It was a slow starter, but the publishers have been rewarded.

"Few technical books," said Mr. Kirkpatrick, "have amassed the record of this one."

He then presented to Professor McAdams a specially bound copy of the book. In it were the signatures of a substantial number of the engineers attending the Conference.

T. B. Drew, professor of chemical engineering at Columbia, recalled incidents of the early days of the heat-transfer technology in which the guest of honor had figured so prominently. He filled in the "human interest" story of Professor McAdams, his work in the Development Division of the Chemical Warfare Service during World War I, and on the National Defense Research Committee in World War II.

"Professor McAdams was a chemical engineer first," he said, "and after that, a heat-transfer man, though the ASME got him in 1926, and the AIChE in 1933."

Professor McAdams, himself, spoke briefly, thanking the Conference for its attention to him, and giving credit to many who, like Professor Drew, had assisted him in the compiling and publication of the book. He spoke especially of his wife, seated nearby, who had done the work of typing the book. All authors will join him in his bow to Mrs. McAdams.

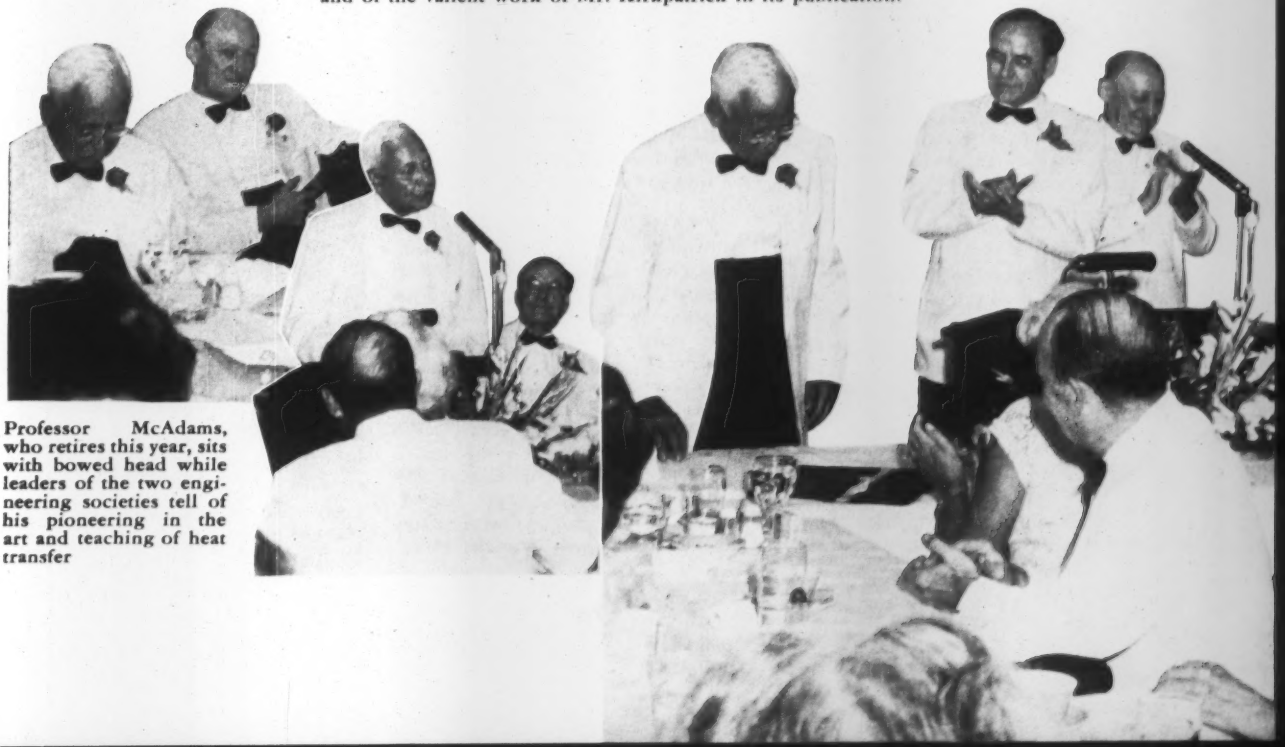
There followed the presentation to Professor McAdams of a citation, awarded jointly by ASME and AIChE, in recognition of his "distinguished service to the engineering profession, and particularly, to the art and science of heat transmission."

Availability List—1957 ASME-AIChE Heat Transfer Conference Papers

THE papers in this list are available in separate copy form until June 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	*Title and Author*
57—HT-1	Heat Transfer to Flow in a Round Tube With Arbitrary Velocity Distribution, by I. R. WHITEMAN and W. B. DRAKE
57—HT-2	Bubble Growth Rates in Boiling, by PETER GRIFFITH
57—HT-3	A Study of Heat Transfer and Pressure Drop Under Conditions of Laminar Flow in the Shell Side of Cross-Baffled Heat Exchangers, by F. L. TEST
57—HT-4	On the Stability of Boiling Heat Transfer, by NOVAK ZUBER
57—HT-5	A New Method of Heat-Exchanger Design With Specified Inlet and Outlet Conditions, by R. S. FAIRALL
57—HT-6	Dynamic Response of Heat Exchangers Having Internal Heat Sources, Part 2, by V. S. ARPACI and J. A. CLARK

Prof. W. H. McAdams addresses the banquet, and bows before an ovation after being presented with a citation for his contribution to science and engineering. In his speech, the author of the definitive work on heat transfer spoke warmly of the help given him by Professor Drew and others in the completion of his book, and of the valient work of Mr. Kirkpatrick in its publication.



Professor McAdams, who retires this year, sits with bowed head while leaders of the two engineering societies tell of his pioneering in the art and teaching of heat transfer

57—HT-7 Heat Transfer to Supercritical Water, by N. L. Dickinson and C. P. Welch

57—HT-8 Heat-Transfer Studies of Naval Boilers, by L. Cohen and W. A. Fritz, Jr.

57—HT-9 Experimental Velocity and Temperature Profiles for Air in Turbulent Pipe Flow, by C. A. Sleicher, Jr.

57—HT-10 Quasilinear Heat Flow, by N. E. Friedmann

57—HT-11 Heat-Transfer Rates to Cross-Flowing Mercury in a Staggered Tube Bank, Part 2, by C. L. Rickard, O. E. Dwyer, and D. D. Dropkin

57—HT-12 Heat Transmission to Fluids With Low Prandtl Numbers for Flow Through Tube Banks, by R. D. Cess and R. J. Grosh

57—HT-13 Combined Free and Forced Convection in a Constant-Temperature Vertical Tube, by T. W. Jackson, W. B. Harrison, and W. C. Boteler

57—HT-14 Modes of Adiabatic and Diabatic Fluid Flow in an Annulus With an Inner Rotating Cylinder, by Joseph Kaye and E. C. Elgar

57—HT-15 Development of Ceramic Insulating Materials for High-Temperature Use, by W. D. Kingery, J. D. Klein, and M. C. McQuarrie

57—HT-16 Heat Transfer in Liquid Metals, by P. S. Lykoudis and Y. S. Touloukian

57—HT-17 Heat Transfer in Internal-Combustion Engines, by C. F. Taylor and Tau-Yi Toong

57—HT-18 The Influence of Gradient Temperature Fields on Thermocouple Measurements, by N. R. Johnson and F. Osterle

57—HT-19 Heat, Mass, and Momentum Transfer in Flow Through Porous Media, by L. Green, Jr.

57—HT-20 The Effectiveness of Stub Fins as Determined by the Teledeltos Paper Analog, by F. Landis and T. Zupnik

57—HT-21 The Correlation of Nucleate Boiling Burnout Data, by P. Griffith

57—HT-22 Heat Transfer in Thin-Film, Centrifugal Processing Units, by A. R. Gudheim and J. Donovan

57—HT-23 Radiant Heat Exchange in a Gas-Filled Enclosure, by H. C. Hottel and E. S. Cohen

57—HT-24 Film Boiling From Vertical Tubes, by Y. Y. Hsu and J. W. Westwater

57—HT-25 Natural Convection Heat Transfer in Regions of Maximum Fluid Density, by R. S. Schechter and H. S. Isbin

57—HT-26 Heat Transfer and Pressure Drop in Odd-Shaped Annuli, by C. Johannes and R. R. Kraybill

57—HT-27 Heat Transfer From Superheated Vapors to a Horizontal Tube, by G. Balekjian and D. L. Katz

57—HT-28 Horizontal Condenser Theory, Part 1, Mathematical Development of Tube Loading, by D. Q. Kern

57—HT-29 Wetting Effects on Boiling Heat Transfer—The Copper Stearic Acid System, by W. B. Harrison and Z. Levine

57—HT-30 Control of Flow Distribution by Mixing Headers, by S. C. Hyman and L. Joseph

57—HT-31 Heat Tansfer Between Fluidized Solids Beds and Boundary Surfaces—Correlation of Data, by L. Wender and G. T. Cooper

57—HT-32 Momentum and Mass Transfer by Eddy Diffusion in a Wetted-Wall Channel, by A. M. Dhanak

57—HT-33 Convective Heat Transfer From High-Temperature Air Inside a Tube, by H. E. Zellnik and S. W. Churchill

57—HT-34 Gas - Friction—Heat - Transfer Charts for Ducted Flows, by S. V. Manson

57—HT-35 Experimental and Analytical Study of Two-Phase Flow in an Ejector With Condensation, by Joseph Kaye and M. A. Rivas, Jr.

ASME Codes and Standards Workshop

American-British-Canadian Conference on Unification of Drafting Practice

An American-British-Canadian Conference to discuss possible unification of the drafting practices of the three countries will be held the second week of October in Toronto, Ont., Canada. This will be the first ABC Conference since the one held in New York, N. Y., in 1952 that has taken up the subject. Completion and approval of the extensive revision of the American Standard Drawings and Drafting-Room Practice (ASA Z14.1-1946) by Sectional Committee Y14 enables a single American viewpoint to be presented. Approval by ASA of the six basic sections of the revision is expected by the time of the Conference.

The American delegation will be headed by Prof. R. P. Hoelscher, Mem. ASME, who is chairman of Sectional Committee Y14. Other members of the delegation will be: P. G. Belitsos; N. E. Brown, Mem. ASME; Leon DeMause; C. H. Heller; E. H. Jones; R. S. Paffenbarger, Mem. ASME; C. H. Springer; Joseph Stannard; Craig Telfer; R. P. Trowbridge, Mem. ASME; and S. H. Watson. In addition, the Department of Defense will name several delegates.

Stanley J. Harley, Coventry Tool and Gauge Company, will head the British delegation, and Lieut. Col. A. N. Huddleston will lead the Canadian delegation.

Principal discussion will concern true position dimensioning, the maximum material concept, and geometric tolerancing. Papers have been prepared and sent to Britain and Canada explaining the background and thinking behind the newly revised American standard.

J. E. Lovely receives ASME Certificate of Award for his work in codes and standards

J. E. Lovely Receives Certificate of Award

JOHN E. LOVELY, Mem. ASME, has received a Certificate of Award for outstanding leadership in the development of codes and standards sponsored by the Society.

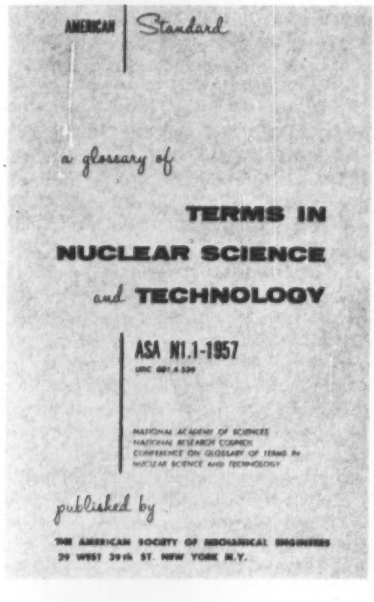
Mr. Lovely represented the Society on Sectional Committee B5, Small Tools and Machine Tool Elements, from 1941 to 1957, and was chairman of B5 TC 11 on Chucks and Chuck Jaws. He was also a member of several subgroups under B5. He represented the Society on Sectional Committee B4, Preferred Limits and Fits for Cylindrical Parts, from 1938 to the present, and was a former chairman of that committee. He was a member of a working committee on Machine Tool Symbols under Sectional Committee Y32.

ASA Approves Nuclear Glossary As American Standard

"THE Glossary of Terms in Nuclear Science and Technology" has been approved by the American Standards Association as American Standard, ASA N1.1-1957.

The Glossary is the first American Standard approved in the field of nuclear energy. It was prepared by committees working under the auspices of the National Research Council of the National Academy of Sciences. Pending ASA approval, it was published as ASME Standard 110 early in 1957.

Copies are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., at $5 each, 20 per cent discount for ASME members.



New American Standard on Carbide Blanks and Cutting Tools

By O. W. Boston, Chairman, B5 TC2

THIS new standard is a section of that on Single-Point Tools and Holders, ASA B5.22, which has been revised and extended by the Carbide Standardization Committee Section of the ASTE National Standards Committee. It covers shapes and sizes of shanks of single-point tools tipped with carbide, and shapes and sizes of circular, square and triangular solid inserts with their holders.

The carbide section represents a complete listing of tips and tools, which will provide industry with data for its own standards, to help in the specification of standardized tools for more economical manufacture.

Single-Point Tool Nomenclature, and Types and Sizes of Tools of high-speed steel and cast nonferrous metal are other sections of the original standard, now being revised.

ASME Coming Events

Oct. 7–9
ASLE-ASME Lubricating Conference, concurrently with ASME-IMechE International Conference on Lubrication and Wear, Royal York Hotel, Toronto, Ont., Canada

Oct. 10–12
ASME-AIME Joint Fuels Conference, Chateau Frontenac, Quebec, Que., Can.

Oct. 21–23
ASME Power Conference, Americus Hotel, Allentown, Pa.

Dec. 1–6
ASME Annual Meeting, Hotel Statler, New York, N. Y.

March 2–6, 1958
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–22, 1958
Nuclear Congress, International Amphitheater Chicago, Ill. (ASME is co-sponsor.)

March 17–20, 1958
ASME-ARS Joint Aviation Conference, Hotel Statler-Hilton, Dallas, Tex.

March 19–20, 1958
ASME-AIEE Engineering Management Conference, Somerset Hotel, Boston, Mass.

April 1–3, 1958
ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10, 1958
ASME Railroad Conference, Hotel Statler, Cleveland, Ohio

1958 Mechanical Catalog Ready for Distribution

DURING October ASME Members who requested a copy of the Mechanical Catalog will receive the new edition.

Designed as an aid in specifying and buying functions, it contains over 50,000 listings, 6000 products of 3500 manufacturers, plus more than 350 pages of descriptive matter of importance to the engineer in industry.

Since 1912 the Mechanical Catalog has been an invaluable reference for engineers in industry. Constant editing of listings, industry-inspired phraseology revisions, and a continuing flow of suggestions from industry have helped make the Catalog the most valuable of its kind.

One important feature of the 1958 edition is the 20-page descriptive listing of all ASME publications, which enables engineers to check quickly their requirements for the latest standards and codes as well as other special data.

April 14–15, 1958
ASME Plant Maintenance Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17, 1958
ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 15–17, 1958
ASME-AWS Metals Engineering Joint Conference, Hotel Statler, St. Louis, Mo.

April 24–25, 1958
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.

May 18–22, 1958
ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

May 22–23, 1958
ASME Wood Industries Conference, Syracuse University, Syracuse, N. Y.

June 11–14, 1958
Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is co-sponsor.)

June 15–19, 1958
ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(For Meetings of Other Societies, see page 986)

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

Meeting in Springfield, Vt.

The boards and committees of ASME are rather well known to the membership at large by the official titles. But, except for a few officers and staff members whose names are well known, it is likely that the names of the members who comprise the various active committees are wholly unfamiliar. For this reason, and because we felt that the readers of "Junior Forum" would be interested in meeting the men who are the current National Junior Committee, we are presenting brief biographical sketches of each of the committee members.

The accompanying photographs were taken at the NJC August meeting which was held in Springfield, Vt.

Senator Flanders Visits With NJC in Vermont

One of the high lights of the Springfield meeting occurred when a distinguished resident stopped in at the NJC session being held on the porch of the Hartness House. This gentleman, past-president and Hon. Mem. ASME, former president of Jones and Lamson Machine Company, and currently United States Senator from Vermont, is Ralph E. Flanders.

In response to several questions, Senator Flanders discussed some interesting contemporary senatorial matters as well as the history of industrial Springfield.

After the Senator's visit the NJC elected a slate of officers for the year 1958. At this time recommendations were made also for the appointment of new members to NJC Executive group and for Junior Representatives to Society committees.

Know Your NJC

Warren R. Thompson. Warren is the present NJC chairman. He's 31, has his degree from Iowa State College (1948) and is a power engineer with United Engineers & Constructors, Inc. He lives in Philadelphia, Pa., is a P.E. in Pennsylvania, Delaware, and Maryland. He is a member of the Engineers' Club of Philadelphia and the Association of Iron and Steel Engineers. He previously worked for the city of Philadelphia. Warren is married.

William V. Chambers. Bill is presently NJC vice-chairman and next year's chairman-elect. His degree is from Bradley University (1950). He works for General Electric in the Aircraft Gas Turbine Division in Cincinnati, Ohio, and previously worked one year for the city of Peoria, Ill. Bill is a P.E. in Ohio, a member of the Evendale Engineer's Association, the Evendale Management Association, and the SAE. He's 28, married, and has two children.

William M. Morley. This Bill is also 28, married, and has two children. He's a graduate of Lehigh (1951) and is a field engineer for the Elliot Company concerned with the sales and servicing of pumps, compressors, and the like. Bill is currently Secretary of NJC and vice-chairman-elect for next year. He's a member of the Engineers' Club of Philadelphia, the AIEE, and the Technical Association of the Pulp and Paper Industry. His home is in Philadelphia.

Peter D. Hansen. Pete is a graduate of the University of Rochester (1952). He is the secretary-elect of NJC for next year. Pete is an instructor in the Dynamic Analysis and Control Laboratory at M.I.T. and is also working for an advanced degree there. He too is a married man.

Richard A. Cederberg. Dick is 29 and unmarried. He received his degree from Kansas State College (1951) and is a production planning and control supervisor for Remington Rand Univac in St. Paul, Minn. Dick was previously with Westinghouse. He is a past secretary of NJC and conducted "Junior Forum" for two years. It was Dick who originated the "Young Engineer In—" Series for the Forum.

Jerome H. Weinstein. Jerry is 29 and a newlywed. He was graduated from the College of the City of New York (1950) and is now an assistant professor of mechanical engineering at the Newark College of Engineering. He received his master's degree from Newark (1955) and is now Faculty Adviser to the Newark College Section of the ASME Student Members. Jerry is also the subchairman of the Committee of Young Engineering Teachers for Middle Atlantic Section of American Society for Engineering Education. He spends his summers in industry and has been with G.E., The Babcock & Wilcox Company, Atlantic City Electric Company, and Rocketdyne.

Robert E. Jonelis. Bob is 32, married, and has two children. He received his degree from Illinois Institute of Technology (1950) and is now with the Commonwealth Edison Company in Chicago, Ill. In the Chicago Section of ASME Bob is chairman of the Associate Committee and a member of the Executive Committee and the Operating Board.

Norman J. Viehmann. Norm is 28, married, and has two children. He owns two acres of a Vermont hill where he is planning to build his home. He received his BSME from Lehigh (1950) and a master's in Business from the University of Michigan (1952). Norm is with the Fellows Gear Shaper Company and was previously with the Jones & Lamson Machine Company. He planned

▲ NJC conferees standing, *left to right,* are: W. A. Shoudy, Old Guard Committee; Ronald C. Mason and R. Searle, guests from Northern New England Section; F. Everett Reed, Mem. ASME and adviser to NJC; W. M. Morley; W. R. Thompson; R. E. Jonelis; H. B. Lindstrom; Don E. Glesman, guest from Minneapolis-St. Paul Section; N. J. Viehmann; H. N. Weinberg; W. E. Reaser, Assistant Secretary ASME; and W. V. Chambers

▶ Men Around Conference Table: *left to right,* R. Searle, R. C. Mason, W. A. Shoudy, F. E. Reed, N. J. Viehmann, W. V. Chambers, W. R. Thompson, W. M. Morley, H. N. Weinberg, R. E. Jonelis, H. B. Lindstrom, W. E. Reaser, D. E. Glesman

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

Vermont in August attracted, *left to right: Front,* Mrs. W. E. Reaser, Danny and Jenny Chambers, Mrs. W. V. Chambers; *rear,* Mrs. N. J. Viehmann, Doug Viehmann, Mrs. F. E. Reed, Mrs. W. A. Shoudy, and Mrs. W. R. Thompson

and was host to the NJC meeting in Springfield.

H. Bernard Lindstrom. Bernie is 28 and hails originally from Holdrege, Neb. He received his degree from the University of Nebraska (1951) and started work with the Rocket Section of the Naval Bureau of Ordinance. He is presently in the Naval Research Laboratory working with the Sonar Systems Branch of the Sound Division. Bernie became the Junior Representative to the Society Meetings Committee in 1954 and a member of the NJC in 1955. He is single, and makes his home in Washington, D.C.

Harold N. Weinberg. Harold is 27, married, and has one daughter. He received his BME (1950) and MSE (1951) from the University of Florida and subsequently served as a 1st Lieutenant in the Army Transportation Corps Research and Development Station. Harold is now in the Planning Engineering Division of Esso Research & Engineering Company and owns his own home in East Brunswick, N. J. He currently conducts Junior Forum, was a Junior Representative to the Publications Committee, and will be a Junior Adviser to the Constitution and By-Laws Committee next year.

Continuation of Listing of State Boards for Engineering Registration

THE following is a continuation of the list of State Boards responsible for professional engineering registration and the persons to whom inquiries should be directed.

New Hampshire State Board of Registration for Professional Engineers, W. E. Haynes, Secretary, c/o Secretary of State, State House, Concord, N. H.

New Jersey State Board of Examiners of Professional Engineers and Land Surveyors, Thomas E. Heathcote, Secretary, 1100 Raymond Blvd., Newark 5, N. J.

New Mexico State Board of Registration for Professional Engineers and Land Surveyors, Mrs. Sybel Clagett, Assistant Secretary, P. O. Box 2074, Santa Fe, N. Mex.

New York State Board of Examiners of Professional Engineers and Land Surveyors, Newell L. Freeman, Secretary, c/o New York State Education Department, 23 South Pearl Street, Albany 7, N. Y.

North Carolina State Board of Registration for Professional Engineers and Land Surveyors, Robert B. Rice, Secretary, P. O. Box 5131, N. C. State College, Raleigh, N. C.

North Dakota State Board of Registration for Professional Engineers, A. L. Bavone, Secretary, P. O. Box 1265, Minot, N. D.

Ohio State Board of Registration for Professional Engineers and Surveyors, Robert N. Waid, Secretary, 21 West Broad Street, Columbus 15, Ohio.

Oklahoma State Board of Registration for Professional Engineers, Gwynne B. Hill, Secretary, 2901 Classen Blvd., 225 Cameron Bldg., Oklahoma City, Okla.

Oregon State Board of Engineering Examiners, E. A. Buckhorn, Secretary, 717 Board of Trade Bldg., Portland 4, Ore.

Pennsylvania State Registration Board of Professional Engineers, Miss Rebecca J. Nickles, Secretary, 324 Education Bldg., Harrisburg, Pa.

Student Members From More Than 100 Schools Meet at Twelve Regional Conferences in Spring, 1957

Prize-winning papers highlight conferences amid inspection tours and social events

MEMBERS of The American Society of Mechanical Engineers Student Sections and their faculty advisers met at 12 Regional Conferences throughout the country in the spring of this year. More than 100 colleges were represented by 1400 student engineers.

The Regional Conference also affords the opportunity for the student to glimpse certain operational aspects of the Society's Annual Meeting. The contributions which that meeting makes to the general membership are sampled from a program which is a reproduction in miniature of the Annual Meeting.

These conferences promote professional development by bringing together student engineers from neighboring schools to compete in presentation of technical papers; to discuss problems of student-section administration; plan for the academic year; listen to leaders in industry, educators, and engineers discuss matters of import to engineers; and generally to enjoy a social program, luncheons, dinners, and plant trips.

Technical Papers

Papers, presented in competition for cash prizes, this year maintained the high standards previously established. A glance at the list of prize-winning papers will reveal the diversity of the subject matter covered by the students. The internal-combustion engine, rocket propulsion, and nuclear power ranked high in the choice of topics chosen by the student speakers.

Several student groups expressed the desire to increase student participation in the papers contest. A suggestion was made that increased prize money from the local parent section or from student dues or fees might induce greater participation. Personal contact, however, and encouragement of individual students along with seminar courses which require papers were suggested as alternate means of creating interest in the papers contest.

Student Section Operation

Meetings were held at each of the Regional Conferences to consider the problems of administration in each of the sections. Chief among the concerns of students and faculty advisers was attendance. Almost all sections reported good representation from the junior and senior classes, but were eager to interest lower classmen. One group had successfully instituted freshman classes in the use of the slide rule in an effort to interest these students. Other groups recommended that field trips improved attendance at section meetings. Another group reported that meetings in conjunction with a luncheon or dinner, or meetings at which refreshments were served, drew a greater response.

The new Student Section Plan, after its first year in effect, was the subject of much discussion. The plan has received wide acceptance and, in many instances, it has contributed to wider enrollment. The new plan provides every student applying for membership with permanent enrollment; first, as a Student Member, and after he has received his degree, as an Associate Member. It is suggested, therefore, that when students make application on the new form, they include their signature, scheduled date of graduation, and the endorsement of their faculty adviser. Dues are $5, and are to be paid to New York Headquarters directly or through the faculty adviser, according to the plan of the individual's school.

Last year's increase in the dues to $5 was a major topic of discussion. Comparison with the dues and benefits of other societies' student groups revealed that this fee is not exorbitant.

Transfer to Associate Member, another of the groups' concerns, was explained. Transfer can be facilitated by notification to New York Headquarters, through the faculty adviser, of Student Members who will be eligible for promotion.

Lectures and Inspection Trips

Industry and education were both represented at lectures and inspection trips sponsored by all of the Regional Conferences.

Tours through such industrial sites as a gear works, an aircraft plant, and a machine company enabled the students to view the mechanical engineer in relation to his work. Tours through the facilities and laboratories of the host colleges gave the student engineers a view of the equipment which is available at other universities for training mechanical engineers.

Speakers from large companies informed the students of what their position would be in the industrial picture. Educators from the engineering faculties, in at least two instances, ventured into two relatively unexplored areas and presented illustrated talks on Africa and Antarctica.

Faculty Advisers

The activities at each of the Regional Conferences and at each of the Student Sections during the entire year reveal the significance of the Faculty Adviser's position. He is mainly responsible for increasing student membership and promoting student transfers. A member of the Society, he must be well-informed and interested in the workings of the Society in order that he might properly advise his students.

1957 ASME Regional Student Conference Winners

REGION I, NEW ENGLAND, TUFTS UNIVERSITY, MEDFORD, MASS., APRIL 12–13, 1957

Attendance: 189 — Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Philip A. Thompson	Fusion	Rensselaer Polytechnic Institute
Second	Lawrence A. Furrer	Adaptation of Axial Flow Compressor Performance Data to Aerodynamic Design Parameters	Dartmouth College

Third	Paul R. Beswick	A New Concept in Rotary Engines	Worcester Polytechnic Institute
Fourth	David Smith	The Hydrosphere Bearing	University of Rhode Island
Old Guard	Richard A. Koffinke	Application of Electric Strain Gages	Northeastern University

REGION II, EASTERN, RUTGERS UNIVERSITY, NEW BRUNSWICK, N. J., APRIL 12, 1957

Attendance: 134 Papers Presented: 6

Prize	*Recipient*	*Title of Paper*	*College*
First	Robert D. Martin	Hazards Associated With the Use of Radioisotopes in Nondestructive Testing Techniques	Polytechnic Institute of Brooklyn
Second	Sigmund Black	Noise and Fatigue	Cooper Union School of Engineering
Third	James F. Wonnell	The Circulating Channel	Columbia University, Mechanical Division
Fourth	Michael J. Truppo	Testing of Model Airplane Propellers	Newark College of Engineering
Old Guard	Walter F. Logeman	Fostering a Spirit of Civic Service	Rutgers University

REGION III, ALLEGHENIES, CATHOLIC UNIVERSITY OF AMERICA, WASHINGTON, D. C., MARCH 29–30, 1957

Attendance: 162 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	William J. Murphy	Reproducible Low Impact Testing	Villanova University
Second	Edward M. Maybeck	A Model Test Basin	University of Rochester
Third	Gerald J. Moyar	Surface Fatigue in Roller Bearings	Princeton University
Fourth	Buford K. Kennedy	Performance of the JAN-S-44 Type Shock Machine	University of Maryland
Old Guard	Cephas L. Green	A Torsion Type Transmission Dynamometer	Howard University

REGION IV, SOUTHERN, ALABAMA POLYTECHNIC INSTITUTE, MISSISSIPPI STATE COLLEGE, UNIVERSITY OF ALABAMA, IN BIRMINGHAM, ALA., APRIL 5–6, 1957

Attendance: 200 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Gilbert B. Ballard, Jr.	Application of Gas Turbines to Automobiles	Alabama Polytechnic Institute
Second	Allen L. Calcote	Free Piston Gasifiers	University of Tennessee
Third	Robert L. Lawrence	The Dynamic Investigation of Push Rod Strains	North Carolina State
Fourth	James W. Follansbee	The Application of Pneumatics to Process Control	University of Florida
Old Guard	Wyatt E. Brumfield	Cathodic Protection for Buried Steel Pipe	Mississippi State College

REGION V, MIDWEST, UNIVERSITY OF CINCINNATI, CINCINNATI, OHIO, APRIL 18–19, 1957

Attendance: 78

Prize	*Recipient*	*Title of Paper*	*College*
First	Albert V. Ferris	Has the Engineer Bypassed Education?	University of Dayton
Second	G. T. Sudderfield	Miniature Gasoline Engines	Ohio State University
Third	Werener I. Staaf	Production and Use of Porcelain-Enameled Aluminum	University of Pittsburgh
Fourth	Charles F. Kummer	Solar Energy	Michigan State University
Old Guard	David L. Lemon	Student Engineering Organizations	University of Michigan

REGION VI, NORTHERN TIER, UNIVERSITY OF WISCONSIN, MADISON, WIS., APRIL 5–6, 1957

Attendance: 92 Papers Presented: 9

Prize	*Recipient*	*Title of Paper*	*College*
First	Matthew T. Orvik	The Effect of Mechanical Engineering on Resistor Board Development	University of North Dakota
Second	Palmer A. Bergh	Can We Meet the Challenge?	South Dakota State College
Third	Peter F. Niesen	Afterburners on a Turbojet Engine	University of Minnesota
Fourth	John G. Bollinger	Man's Greatest Challenge in Materials Handling	University of Wisconsin
Old Guard	None mentioned		

REGION VI, SOUTHERN TIER, NORTHWESTERN UNIVERSITY, EVANSTON, ILL., MAY 2–3, 1957

Attendance: 94 Papers Presented: 9

Prize	*Recipient*	*Title of Paper*	*College*
First	George M. Reynolds	Computor Control of Machine Tools	Northwestern University
Second	Howard L. Chambers	Design of a Small Rocket Engine	Rose Polytechnic Institute
Third	John G. Wright	A Worm in the Oil Patch	Missouri School of Mines & Metallurgy
Fourth	Richard Thomas	A Machine for Applying Multiconstituents Casting Resins	University of Notre Dame
Old Guard	None mentioned		

REGION VII, PACIFIC NORTHWEST, UNIV. OF WASHINGTON, SEATTLE, WASH., MAY 9–11, 1957

Attendance: 118 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	John R. Gordon	The Martin Baker Ejection Seat MKCF2	University of British Columbia
Second	Michael Maes	A Rocket Engine Investigation	University of Washington

(Continued on next page)

Third	Glen Schmidt	Air Cooling of the Cold-Mold Crucible for ARC Melting	Oregon State College
Fourth	Norman Adsit	A Comparison of Mechanical Properties of Quenched and Test-Hardened S.A.E. 1065 8660 Steel	Oregon State College
Old Guard	Richard D. Burgoon	Hazards of Working in Compressed Air	University of Washington

REGION VII, PACIFIC SOUTHWEST, UNIVERSITY OF NEVADA, RENO, NEV., APRIL 26–27, 1957

Attendance: 74 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	John M. Bristol, Jr.	Design and Test Operation of a Hydrafoil	University of Santa Clara
Second	Douglas P. Hines	A Correlation Function Generator	University of California
Third	Harry W. McSwain	Fuel-Injection Engine	University of Utah
Fourth	Lewis M. Gibbs	The Importance of Combustion Products on Engine-Power Output	University of California
Old Guard	Kirk S. Irwin	The Use of Lead to Simulate High-Temperature Physical Properties of Structural Materials	California Institute of Technology

REGION VIII, NORTHERN TIER, OKLAHOMA STATE UNIVERSITY, STILLWATER, OKLA., APRIL 29–30, 1957

Attendance: 139 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Larry A. Rash	Thermo Electric Power	Kansas State College
Second	Jon R. Busse	Shock-Wave Interference of Compressor Blading	University of Arkansas
Third	John J. Shelton	The Horsepower Race in European Race Cars	University of Oklahoma
Fourth	George F. Keys	A Small Secondary Oil Recovery Operation	University of Arkansas
Old Guard	Kay L. Cornelius	Roof Cooling With Water	Kansas State College

REGION VIII, SOUTHERN TIER, TEXAS TECHNOLOGICAL COLLEGE, LUBBOCK, TEXAS, MARCH 22–23, 1957

Attendance: 92 Papers Presented: 14

Prize	*Recipient*	*Title of Paper*	*College*
First	Jack C. Brady	An Investigation of the Hilsch Tube Vortex	A&M College of Texas
Second	Carey E. Murphey	Aviation Oxygen Requirements and Equipment	University of Texas
Third	Gilbert L. Jamison	Humanities Battle Against Heat and Fatigue	University of Texas
Fourth	Travis W. Binion, Jr.	The Effects of Vibrations Upon the Heat-Transfer Coefficient	Texas Technological College
Old Guard	None mentioned		

REGION VIII, ROCKY MOUNTAIN TIER, UNIVERSITY OF DENVER, DENVER, COLO., APRIL 12–13, 1957

Attendance: 117 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Daryl R. Schwichtenberg	A Pure Reaction Gas Turbine	South Dakota School of Mines & Technology
Second	Frederick J. Moody	Trailer-Load Planner—Highway Security Plus Legal Maximum Payload	University of Colorado
Third	Dale H. Burnworth	Perimeter Heating and Air Conditioning	University of New Mexico
Fourth	James O. Murcklen	Engineer's Dilemma	New Mexico A&MA
Old Guard	William R. Orr	Servomechanisms	University of Denver

Prizes Other Than Papers Presented at Regional Student Conference, 1957

1 Two prizes of $25 and $15 were awarded at each Conference to the Student Sections, other than the Host College, having the largest and next largest percentage of Student Members attending.

2 A Certificate was presented at each Conference to the Student Section having the largest percentage of potential Student Members in the third through sixth years among Student Sections participating.

3 Each Conference presented a Man-Mile trophy for the Student Section that traveled the greatest number of man-miles to the Conference. The winners are listed in the following table:

Region	*$25*	*$15*	*Potential Student Membership Certificate*	*Man-Mile Trophy*
I	Worcester Polytechnic Institute	Northeastern University University of Rhode Island	Worcester Polytechnic Institute	University of Vermont
I	Polytechnic Institute of Brooklyn	Pratt Institute	Newark College of Engineering	Polytechnic Institute of Brooklyn
II	University of Maryland	Howard University Villanova University	University of Delaware	University of Rochester
IV	Vanderbilt University	University of Tennessee	Vanderbilt University	University of South Carolina
V	Wayne State University	University of Toledo	Ohio Northern University	Wayne State University
VI—Northern Tier	South Dakota State College	Iowa State College	University of North Dakota	South Dakota State College
VI—Southern Tier	Bradley University	Missouri School of Mines & Metallurgy	Rose Polytechnic Institute	Missouri School of Mining & Metallurgy

VII—Pacific Northwest			
Oregon State College	University of Idaho	University of British Columbia	Montana State College Oregon State College
VII—Pacific Southwest			
University of Utah	University of California	University of Nevada	No winner mentioned
VIII—Northern Tier			
University of Oklahoma	Kansas State College	University of Oklahoma	Kansas State College
VIII—Southern Tier			
Southwestern Louisiana Institute	Louisiana Polytechnic Institute	Southwestern Louisiana Institute	Southwestern Louisiana Institute
VIII—Rocky Mountain Tier			
University of Wyoming	Colorado State University	University of Denver	South Dakota School of Mines & Technology

Engineering Societies Personnel Service, Inc. (Agency)

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

Men Available[1]

Project Engineer, BSME, 26, five years' experience in design, stress analysis, hydraulics, project direction, research and development in aeronautical and mechanical structures, and mechanisms graduate work. Prefers Long Island or lower Conn. ME-436.

Director, design, development, or research. Will upgrade product or technical staff, or develop new product or product lines. Over 27 years of stable and progressive experience from design fundamentals to co-ordination of design, development, and research activities in light to heavy machinery, appliances, ordnance, etc. MS in mechanical engineering; registered. ME-437.

Mechanical Engineer, BSME, 33; seven years' experience in design and manufacture of medium and heavy industrial machinery. Application, specification writing, design, supervision, customer liaison, and project responsibility. Seeks position with supervisory and/or administrative activities. Location open. ME-438.

Sales Engineer, BME, BBA 32. Nine years drafting, accountancy, purchasing, and field sales in petroleum industry. Interested mechanical equipment sales. Prefers work in U.S.A. ME-439.

Senior Mechanical Engineer, BSME, MME registered, 35, 14 years' experience; research development and consulting in fluid mechanics system dynamics, heat transfer, and thermodynamics. Some subminiature electromechanical development. Competent for technical, administrative, and business responsibility on development projects. Prefers eastern U.S. ME-440

Plant Engineer, BSME, 34. Ten years' experience in marine and industrial-plant engineering, including design, construction, operation, and maintenance of power plants and process equipment. Supervisory and staff positions held in plant organizations (chemical and steel industry). Prefers East or South. ME-441-9312-Detroit.

Mechanical Engineer, BSME; 35. Seven years' experience in construction, supervision, installation, and testing of hydroelectric machinery such as turbines, pumps, generators, and auxiliaries. Co-ordinated the work of contractors, manufacturer's representatives, and operation personnel; two years development work. Prefers San Francisco, Calif. ME-442-449-San Francisco.

Project Engineer, BME, 31. Nine years' experience in fields of heat transfer, gas flow, fluid dynamics, and machinery development for increased speed and automation. Positions were generally in supervisory capacity for two thirds of this time. Prefers northern N. J. ME-443.

Engineering Executive, BSME, managing capacity, 29 years' experience in all phases of plant engineering and construction, excellent health, relocation no problem. ME-444.

Mechanical-Industrial Engineer, BME; MIE ½ completed; 27; single; veteran; two and one-half years' industrial experience in prototype electronic design, cost estimating, planning and scheduling, supervision of designers, draftsmen, and technicians, and client contact. Prefers New York metropolitan area. ME-445.

[1] All men listed hold some form of ASME membership.

Positions Available

Product Managers, staff positions, reporting to general manager, to develop and co-ordinate the execution of sales, engineering, purchasing, manufacturing, and financial plans. Will work with engineering to obtain design and cost acceptance for new or improved designs; co-operate with manufacturing and purchasing in introducing and producing new products, in development of profit plans and financial controls of product operations, etc., covering oil-field accessories. $12,000–$15,000, plus bonus. Southwest. W-5275.

Sales Manager to organize and administer a sales department for company manufacturing oil-field accessories. Will direct activities of planning section of the sales department, direct the activities of the various sales representatives and co-ordinate efforts of the Customer Service sections; direct activities of customer service, warehousing, and price analysis; work with general manager in conceiving and executing company objectives, policy, and plans, etc. $20,000–$30,000. Pa. W-5276.

Engineers. (*a*) Assistant chief engineer, under 40, mechanical or electrical graduate, at least five years' supervisory design and development experience covering precision instruments, electromechanical devices, and testing equipment. $12,000–$15,000. Company pays placement fee. (*b*) Assistant sales manager, under 40, mechanical or electrical graduate, sales and office-administrative experience covering precision electromechanical equipment. Some traveling. $10,000–$12,000. Company pays placement fee. Conn. W-5304.

Mechanical Engineer, familiar with dust control equipment, its application in industry and patent procedures. East. W-5308.

Assistant Manager, thermal and hydraulic design group, 35–45, mechanical graduate, at least five years supervisory steam-power plant design, project engineering, and administrative experience. $11,000. Eastern Canada. F-5310.

Manufacturing Engineer, degree in engineering, ten to 15 years' experience in manufacturing, preferably in small metalworking industries, machining nonferrous castings, forgings, bar, and strip stock. Must be familiar with and able to direct manufacturing processes on high production machinery used in the manufacture of such materials. Should be familiar with production control systems and manufacturing scheduling. To $10,000 a year, plus fringe benefits. (*b*) Methods engineer, engineering degree preferred, considerable experience in tools, equipment, and machinery used in the manufacture of nonferrous castings, forgings, bar, and strip stock. Assignment for a year will be engineering design, specifications, and procuring of machinery and equipment, and tooling to set up a newly constructed building; engineer transfer of tools, machines, and equipment. After transfer, will take over regular duties of methods engineering. To $8500 a year, fringe benefits. Pa. W-5313.

Product-Development Engineer, preferably graduate mechanical, 25–45, four to five years' experience in product development, application, or allied fields. Should be acquainted with metalworking, i.e., machining, fabrications, and welding. $8340–$9000. West Coast. W-5316.

Senior Engineer, Mechanical, graduate, 45–60, minimum of 20 years' experience in engineering for production, methods, facilities, and maintenance of manufacturing plants as related to large foundry production, diversified machinery production, and general machine-shop production. Should be well-versed with most modern methods, materials, and equipment. Will act as consultant and adviser to foreign governmental agencies and private enterprises, to review, analyze, and prepare engineering economic reports. Climate subtropical; transportation expenses and quarters allowance paid. Salary commensurate with past earnings and experience. Duration, ten months with possibility of extension. Far East. F-5321.

Manager of Industrial Engineering, mechanical or industrial graduate, supervisory industrial-engineering experience covering production methods, standards, costs, etc., in machine shop, sheet metal, I.C. engine, and fabrication and assembly fields. $10,000–$14,000. Okla. W-5328C.

Market Research Manager, Sales Division 28–35, college graduate, some market-research and business-administration subjects, one to three years selling experience, and three to five years over-all market research, of which two years should have been in a supervisory capacity. Work will concern sales analysis, sales forecasting, investigation of new products, and product

improvement. Travel approximately 50 per cent of time $10,000–$12,000. Headquarters, Pa. W-5336.

Sales Engineer, 28–40, graduate mechanical or electrical, preferably married, five or more years' selling experience, for company whose business is plastic extrusions for industry. Travel four to five days a week; home every weekend. To start $9000, plus expenses. Territory, New England, N. Y., Ill., Mich., Headquarters, Mass. W-5337.

Industrial-Management Engineer, 30–40, mechanical or industrial graduate, considerable managerial staff experience covering administration, preparation of reports, business analysis, cost analysis, systems, and procedures, etc. $15,000–$20,000, plus extras. Middle East. F-5339.

Technical Editor or Writer for trade publication, graduate mechanical, with one to three years' experience in shop or methods in manufacturing. $6000–$6500. Mass. W-5344.

Product-Development Engineers, 25–35, mechanical graduates, for design, model shop, and testing of pumping, water-treating, and spraying equipment. $6000–$8000, plus liberal benefits. Ohio. W-5347.

Research and Development Engineer, mechanical graduate, two to five years' product-research and development experience on small mechanical parts in ferrous and nonferrous fields. $7200–$8400. Conn. W-5348.

Station Superintendent, graduate mechanical or electrical, for a new 44-mw steam-electric generating station. Considerable experience required. Salary open. Midwest. W-5351C.

Teaching Personnel: (*a*) Instructor, BS(ME), to teach time study, methods, quality control, machine design, etc. $4500–$5000. (*b*) Instructor-assistant professor, BS in engineering, to teach statics, strength of materials, and materials-laboratory courses with opportunity for research and advanced degree. $3900–$5500. Pa. W-5358.

Chief Engineer, 35–45, engineering graduate, at least ten years' experience covering electro-mechanical and acoustic devices, to take charge of design group. Must have had administrative experience. $12,000–$15,000, plus bonus. New York metropolitan area. W-5359.

Product-Design Engineer, graduate mechanical, 32–45, to head up product design of industrial rotary, positive-displacement pumps; fluid motors; and accessories. Will lead to position of assistant chief engineer for a manufacturer of pumps. $10,000. Employer will negotiate fee. Chicago, Ill. W-5360-C-6461.

Mechanical Engineer for hi-fi product line for broad responsibilities covering production engineering, product design, and advanced development associated with mechanical aspects of hi-fi amplifiers, speakers, and possibly tuners. Will work with factory on production problems, with vendors on vendors' problems, etc. Small group in fast expanding division. Hi-fi product experience not essential but related experience in products such as television and radio, measuring instruments, communications, etc. desirable. $9000–$10,000. Upstate N. Y. W-5368.

Industrial-Management Engineers, production, application, and marketing experience, in cement, lumber, hide, wool, sugar, and other raw material fields. $8000–$10,000, plus $3600 living allowance. Must be U.S. citizen. Middle East and Far East. F-5369.

Chief Engineer, graduate mechanical or electrical, 40–55, with a minimum of 15 years in all phases of product development, design, and manufacturing engineering including tooling, methods, and process engineering; minimum of five years' experience as chief engineer. Will have complete responsibility for all phases of engineering, i.e. product research, development and quality control; manufacturing engineering consisting of tool engineering (design, construction, tryout, repair, modification); machine design; plant layout; methods, standards, and processing, etc. $12,000–$15,000. New England. W-5371.

Spring Engineer, experience in design and development of precision compression, extension, torsion, and flat coiled springs. Salary open; company pays placement fee and relocation allowance. New York metropolitan area. W-5372.

Plant Engineer, 40–45, experience in maintenance, steam and electrical, to handle the maintenance, repairs, construction, steam, and electrical power in a small two-machine paper mill. No pulp mill but a bleaching system. Paper-mill experience not a prerequisite. Salary open. Midwest. W-5373.

Senior Design Engineer, mechanical graduate, design and development experience on large rotary compressors. $10,000–$12,000. Midwest. W-5377.

Industrial Engineer, extensive experience in work measurement, development of standard practices, and establishment of standards for maintenance work in following industrial areas: machine shop, electrical work, pipe fitting, masons, and laborers. This work should have been performed as industrial executive; also substantial consulting experience. $10,000–$12,000. Italy. F-5381.

Plant Engineer, production and packaging experience, for improving operations in wax-products plant. Salary open. Newark, N. J. W-5382.

Design Engineer, mechanical graduate, design, product-engineering, and rating experience covering heat exchangers and chemical-processing equipment. $8000–$9000. Va. W-5385.

Assistant Production Engineer, 25–30, mechanical graduate, experience on metal and plastic small parts to do trouble shooting, improve production methods, redesign equipment and products, etc. $6000–$9000. Within commuting distance of Worcester, Mass. Company prefers a resident of that area. W-5386.

Department Head for newly created ME department, preferably PhD but will consider an MS in mechanical engineering. Must have both industrial and educational experience. $8000–$9500. West. W-5391S.

Plant Superintendent, ME degree preferred. Must have line experience; cannot consider strictly staff man. Know tooling, methods, supervision, planning, plant layout, etc. Full responsibility for about 150 productive people, six foremen; production and material control, incentives, timekeeping, purchasing, etc. Complete manufacturing responsibility for small parts of machine department as well as assembly departments, stock room, etc., no union, incentive rates. Must have superior intelligence and understand problem in handling women employees for a manufacturer of microphones and receivers. Employer will negotiate fee. $12,000–$15,000, plus bonus. N. W. Chicago, Ill. C-6431.

Chief Engineer, Process-Design Department, mechanical or chemical, about 40, at least 15 years' experience in design of chemicals, petroleum, or similar process plants. Should be well-qualified to make feasibility studies; developing process-design data, report capital and operating-cost estimates, and direct actual design of these facilities. Normally about 20 men will be under jurisdiction of chief engineer. Some travel. $10,000–$12,000, plus profit sharing and opportunity for associate status within two years. St. Louis, Mo. C-6439.

Senior Designer-Hydro Installations, ME, 40, five to 15 years' experience in complete mechanical design of large hydrogenerators installations; well-informed about turbines, generators, pumps related to hydropower plant and dam equipment, machines and gates, valves, piping, controls, and auxiliaries; able to provide designs, specifications, and to consider and recommend appropriate means, materials, equipage, and arrangement; to direct, supervise others in preparation of plans and designs; and to relate work of this group with others for an engineer-builder. $8400–$9600, plus benefits. Interview and/or relocation expenses paid. San Francisco, Calif. S-3066.

Chief Designer, heating, ventilating, air conditioning, plumbing, ME, about 35, at least ten years' experience for large industrial, utility, and commercial-type installations; able to meet and deal with clients, handle personnel, and run a mechanical division of ten to 50 persons in an engineering department of 150–200 for an architect-engineering firm. Desirable that applicant also be informed regarding pneumatics, hydraulic, and other industrial plant services. $12,000, plus sick and accident, vacation, liberal fringe benefits, air-conditioned offices. Employer pays placement fee and relocation expenses. Location, Los Angeles, Calif. S-3068.

Superintendent Production—Phosphates, ChE or ME, to 45, five to ten years' experience materials handling and processing, dry and wet processing for fertilizer and acids—rock to finished products. Able to handle supervisors, technical aids, and 120 men. Reports to plant manager. About $8400. Employer will negotiate placement fee. Utah. S-3085.

Designers—Phosphates Plant, ME or ChE background, to 45, five years' making studies and drafting plans and layouts for construction, equipment installation, or modification for process-plant expansion or maintenance. Involves materials handling and dry and wet process for acids and fertilizers—rock to finished products. Reports to chief engineer. $6000 and up. Employer will negotiate placement fee. Utah. W-3086.

Manager Production—Electronics, ME, electronic experience, to 45, minimum of five years' direct production supervision in all manufacturing phases of medium-sized electronics communication equipment from components assembly, chassis preparation, enclosure fabrication, finishing, and packaging. Thoroughly familiar with methods, equipment, job duties and able to set up and operate a manufacturing plant, and to contact and deal with users, suppliers, and others in the field. Should know West Coast operators, plants, and personnel. About $12,000. San Francisco Bay area, Calif. S-3088.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after Oct. 25, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Transfers

Alabama

KOELLIKER, ERNEST B., Mobile
•LLOYD, HOMER M., JR., Birmingham
PAYNE, THOMAS C., Mobile
RICHESON, JAMES P., Decatur
WATSON, JAMES H., Mobile

• Transfer to Member or Affiliate.

Arizona

•LOCKE, JAMES D., Phoenix

Arkansas

ANDERSON, JOHN W., JR., North Little Rock
WINN, BRUCE H., Bauxite

California

•DILLAWAY, ROBERT B., Woodland Hills
FIDRYCH, LEON F., Los Altos
•KING, ROBERT I., Palos Verdes Estates
KOUT, THEODORUS W., San Jose
SINGMAN, CALVIN, Van Nuys
•WILKES, EDMUND, 3RD, Sherman Oaks

Colorado

TOWNSEND, PHINN W., JR., Denver

Connecticut

•CROSSLEY, HARRY E., JR., Stratford
DE LUCA, FRANK, Thompsonville
GALLANT, REGINALD R., Milford
KLONOSKI, ARTHUR F., Torrington
NELSON, HOWARD W., New Britain
•WONG, ARTHUR H., Groton

Delaware

ROMANO, JOHN E., Wilmington

District of Columbia

HULL, BERNARD S., Washington
JEWELL, DAVID A., Washington
LOSCALZO, JOHN J., Washington

Florida

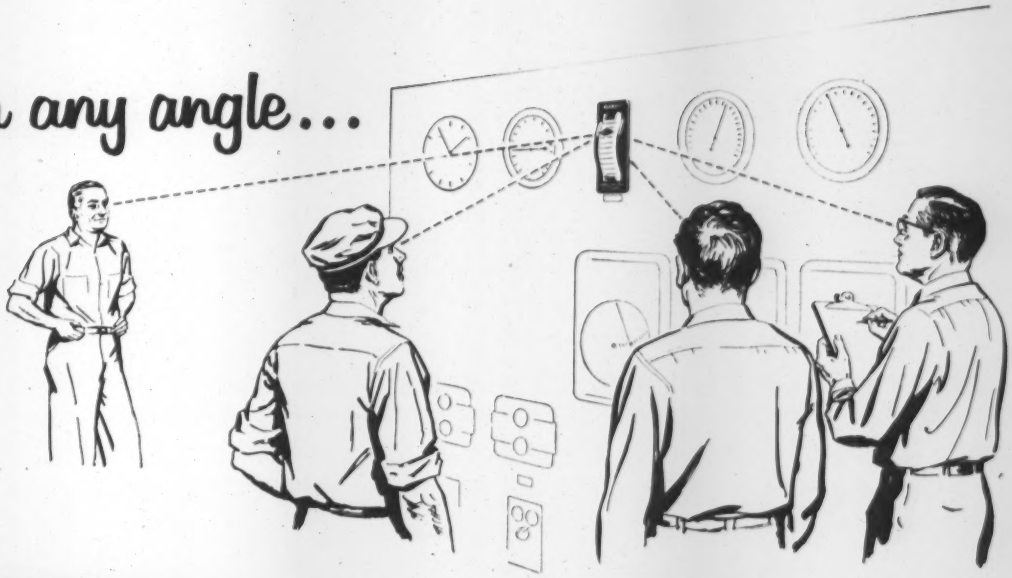
KISH, LOUIS A., Panama City

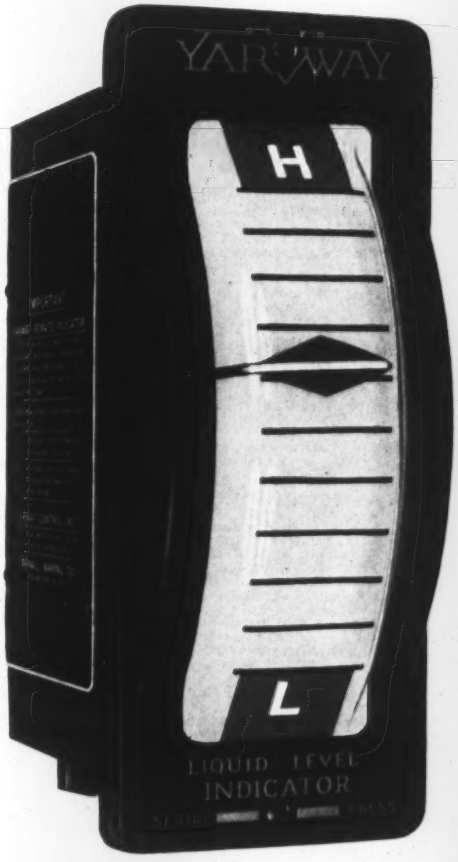
Illinois

•ANDERSON, DONALD R., Downers Grove
BERENDES, JOHN R., Chicago
CULP, EDWIN R., Bellwood
DURGIN, RICHARD L., Chicago
GILLESPIE, NORMAN E., Chicago
•LOFTHOUSE, FRED R., Pekin
PFEIFFER, HARRY F., Glenview
O'BRIEN, ROBERT J., Chicago
REDMOND, LAWRENCE C., Chicago

(ASME News continued on page 1010)

from any angle...





BOILER WATER LEVELS ARE EASIER TO READ with YARWAY INDICATORS

No matter where you stand, you can see at a glance your boiler water level in the Yarway Remote Liquid Level Indicator. The clear, "wide vision" face permits easy readings from any point in a 180° arc.

Readings are instant and accurate because the operating mechanism is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum. Pointer mechanism is never under pressure.

Yarway Remote Indicators are available fully compensated for every change in boiler temperature and pressure and they can be connected to Electronic Secondary Indicators or remote Hi-Lo Alarm Signals (lights or horns), located at any other point in the plant. Also available, Yarway Recorders working on same simple principle.

Over 12,000 Yarway Remote Indicators already installed.

Write for full details on Yarway Indicators for boilers, heaters and other applications. Bulletin WG-1824 tells all, shows typical hook-ups.

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...a good way to specify remote liquid level indicators

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PARHAM, MARSHALL L., JR., Baltimore
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BENNETT, J. WILLIAM, Springfield
BLISSITT, ALBERT, Boston
BLOOM, CARL, Springfield
BRANCO, HAROLDO L. C., Belmont
CHMURA, THEODORE S., Chicopee
●COPIAN, LOUIS P., Worcester
ENGLAND, JOSEPH I., West Brookfield
JENSEN, JAMES N., JR., Hingham

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BREKMAN, MYRON C., Detroit
OBLINGER, FRED G., Livonia
SMITH, VALENTINE J., Dearborn

Minnesota

●DART, ROBERT S., Minneapolis
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Mississippi

SWAIN, EDGAR P., Natchez

Missouri

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GOOD, JOSEPH C., St. Louis
MCCLURKEN, MARTIN H., St. Louis

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VICKERS, JOHN M. F., Lincoln

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BRADY, GEORGE W., Wood-Ridge
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HAESSLER, WALTER M., Newark
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LIBERMAN, WILLIAM, Livingston
LOTTES, JOHN R., Mahwah
MARCHAK, NICHOLAS, Mountainside
STRANO, ANTHONY W., Irvington
WYZALEK, LEONARD J., Pompton Plains

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●O'BRIEN, PAUL D., Los Alamos

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CEDERBERG, BERNT, Wellsville
CLAYTON, WALTER N., Schenectady
CUNNINGHAM, GEORGE M., Corning
DEMATTEI, ANTHONY R., Elmont
DENTON, JOSEPH R., New York
●DHANAK, AMRITLAL M., Schenectady
ELMAN, EDWARD F., Rochester
GABEL, ISADORE, Douglaston
GAFFNEY, JAMES P., Poughkeepsie
●GELOFF, DIMITRI, Syracuse
GOSSIE, MIJO A., Corning
HAHN, JAMES L., Utica
●HALPORN, ARNOLD D., JR., New York
●KALLEN, HOWARD P., Massapequa
LA BRUNA, ANTHONY J., Buffalo
MACHELL, ARTHUR R., JR., Schenectady
●NONACK, VICTOR Z., Huntington
NUNLIST, ERWIN J., Rochester
●PEDERSEN, HARRY, Rochester
PRATT, HARRY H., West Nyack
●ROSS, RONALD J., Syosset
RUBINSTEIN, ANTON, Jackson Heights
SEDDON, ARTHUR H., JR., Schenectady
●SWEENEY, FRANCIS J., JR., Roosevelt, L.I.
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●WAKELAND, HENRY H., New York
WALKER, THOMAS U., Watertown
WEINER, MAURICE M., Schenectady
WHITE, RICHARD C., New Hartford
WHOLL, IRVING M., Brooklyn
YOUNG, RICHARD L., Webster

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MORSE, JAMES W., JR., Euclid
OSBORNE, HERBERT L., Middletown
RECHIN, FRANCIS J., Mentor
●ROCK, SEYMOUR B., Cleveland
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SITTEL, RICHARD L., Tulsa
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BROWN, ROBERT O., Philadelphia
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DAVIS, WILLARD F., Pittsburgh
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HARRISON, MICHAEL E., Levittown
*LAIRD, WILLIAM M., Pittsburgh
LAPOINT, JACQUES R., Pittsburgh
LINK, W. HAROLD, Ridley Park
●LINTON, WILLIAM H., Pittsburgh
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MITCHELL, SAMUEL W. W., Springfield
●ROHMANN, CHARLES P., Hatboro
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OLCOTT, ROLAND B., Aiken
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SHOOK, RYAN A., Dallas
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Vermont

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WILLARD, DONALD C., Charleston

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O'BRIEN, RICHARD E., Manitowoc
PECKHAM, DAVID G., La Crosse
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BADRENA, FRANCISCO A., Hato Rey, Puerto Rico
BOWMAN, KARL A., Honolulu, T.H.
DISSANAYAKE, SIRI S., Colombo, Ceylon
*ELAND, CLIFFORD G. M., Toronto, Ont., Canada
FELDMANN, BERNARD, Rehovot, Israel
HADDOW, JAMES B., Edmonton, Alta., Canada
HARRIS, LOWELL B., Den Haag, Netherlands
HUSSAIN, MOHAMMAD I. M., Karbala, Iraq
MASON, JOHN W., Halifax, N. S., Canada
PARKINSON, GEOFFREY V., Vancouver, B. C., Canada
PEREZ, ANGEL A., Mayaguez, Puerto Rico
RON, SHIMON, Givataim, Israel
TEYEN, THEODOOR J., Windsor, Ont., Canada

Transfers from Student Member to Associate Member, Class of 1956 3

Obituaries

Richard James Brittain, Jr. (1892–1957), assistant chief engineer, Hyatt Bearings Division, General Motors Corp., Harrison, N. J., died May 24, 1957. Born, Newark, N. J., May 24, 1892. Education, received private engineering instruction and attended night school. Married Florence Hibbard. Mem. ASME, 1949. Held about 50 patents assigned to Hyatt Bearings Division, General Motors Corp. Survived by his widow, and three daughters, Mrs. Barbara Whitaker, Oroville, Calif.; Mrs. Marjorie Sims, Houston, Texas; and Mrs. Jan Haven, Twinsburg, Ohio.

Douglas Bernard Carr (1898–1957), general supervising engineer, Cleveland Electric Illuminating Co., Cleveland, Ohio, died June, 1957. Born, Bala, Ont., Canada, Feb. 7, 1898. Education, ME certificate SPS, 1921. Mem. ASME, 1955. Served in the U. S. Army during World War I. Mr. Carr had been associated with the Cleveland Electric Illuminating Co. since 1924.

Edgar Fabian Cohen (1891–1957), chairman of the board, Michel-Cather industrial advertising agency, New York, N. Y., died June 12, 1957. Born, New York, N. Y., April 28, 1891. Education, BS, City College of New York, 1910; ME, Columbia University, 1913. Married Lillian Dornholz. Mem. ASME, 1942. Survived by his widow.

John J. Csisek (1899–1957), methods engineer, Cameron Pump Division, Ingersoll Rand Co., Phillipsburg, N. J., died June 21, 1957. Born, Pesac, Roumania, Feb. 14, 1899. Parents, John and Katherina Csisek. Education, BS, Drexel Institute of Technology, 1920. Naturalized U. S. citizen, 1925, Philadelphia, Pa. Married Anna Agnes Hopkins, 1928; one son, John J., Jr. Jun. ASME, 1928; Assoc. Mem. ASME, 1933; Mem. ASME, 1935. Survived by his widow and son.

Piero Ferrerio (1882–1957), president and chairman, Italian Edison Company, Milan, Italy, the most important public-utility operating and construction company in Italy, died June 25, 1957. Born, Bernareggio, Milan, Italy, May 8, 1882. Education, Milan Institute of Technology, 1907. Mem. ASME, 1952. Mr. Ferrerio began his distinguished career in 1907 as a consulting engineer. In 1916 he joined the Societa Telefonica Italiana, as general manager. From 1920 until the time of his death he was associated with the Italian Edison Company. He successively held positions as assistant general manager, general manager, managing director, and in 1944 became chairman and president. The Italian Edison group also includes firms active in such fields as transport systems, steel mills with electric furnaces, machine works, electrochemical works, contractors, and so forth. Since June, 1940, Mr. Ferrerio had been chairman of the National Association of Italian Power Companies. He was a member also of the Steering Committee of the International Union of Producers and Distributors of Electrical Energy, and the Union for the Co-ordination of Production and Transmission of Electricity. In 1952, the Society honored him by naming him the Calvin W. Rice Lecturer. His lecture, "The Italian Power Industry," gave an historical account of its development and growth.

Robert Gray Griswold (1880–1957), retired executive, Cities Service Co., New York, N. Y. died May 30, 1957. Born, West Salem, Wis., July 6, 1880. Parents, Henry Daniel and Jennie Lee (Dudley) Griswold. Education, BS(ME), University of Wisconsin, 1904. Married Mary M. Cox, 1905. Mem. ASME, 1922. Mr. Griswold, a fuel specialist, held nine patents. He was a licensed and registered engineer in 13 states. A charter member of the American Gas Association, he was also a member of The Franklin Institute, the American Petroleum Institute, and The American Chemical Society.

Charles Hallman (1906–1957), owner of the Hallman Co., Cleveland, Ohio, died June 24, 1957. Born, Montclare, Pa., April 22, 1906. Parents, Charles and Florence Hallman. Education, BS(ME), Pennsylvania State College, 1928. Married Mabel Prentice Roehm, 1937. Mem. ASME, 1953. His papers had been published in the technical press. Survived by his widow.

Heinrich Kriegsheim (1868–1957), retired director and president, Permutit Co., New York, N. Y., died April 22, 1957. Born, Mainz, Germany, Jan. 9, 1868. Parents, Edward and Anna Kriegsheim. Education, graduate Technical Hochscule, Darmstadt, Germany. Naturalized U. S. citizen, 1922, New York, N. Y. Held U. S. and foreign patents on water-conditioning equipment, published articles relating to boiler plates. Mem. ASME, 1924.

Harry Stanley Rogers (1890–1957), president, Polytechnic Institute of Brooklyn, New York, N. Y., died June 6, 1957. Born, Detroit, Mich., Aug. 7, 1890. Parents, Samuel Hartshorne and Martha (Hall) Rogers. Education, BS, University of Wyoming, 1914; CE, 1926; hon. ScD, Northeastern University, 1935; hon. LLD, Uni-

(ASME News continued on page 1012)

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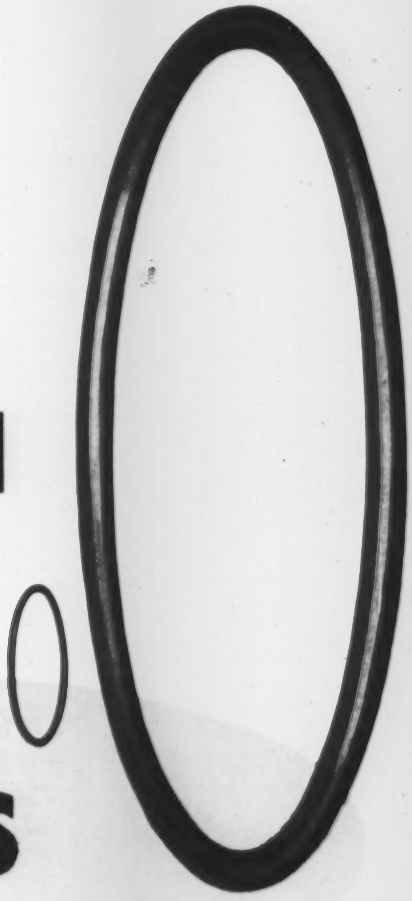

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versity of Wyoming, 1942; and DE, Rensselaer Polytechnic Institute, 1950. Married Grace F. Larson, 1916. Mem. ASME, 1949. Mr. Rogers began his career as an educator in 1914 as an instructor at the University of Iowa. He later taught civil engineering at the Universities of Wyoming and Washington, and at Lafayette College. He joined the faculty of Oregon State College as a professor of hydraulic engineering in 1920. In 1927, he was made dean of engineering, and in 1928, director of the Engineering Experimental Station. He served in these capacities until his appointment as president of the Polytechnic Institute of Brooklyn in 1933. Throughout his career, Dr. Rogers had been active in the work of the American Society for Engineering Education, serving several terms on the Council, one term as vice-president, and two terms as president. In 1953, he received the society's Lamme Award for achievement in his field. He served as chairman of the Engineers' Council for Professional Development. Throughout his career he was identified with educational, civic, and business interests. He served as a vice-chairman of the board of the Long Island College of Medicine, as a member of the Board of Higher Education of the City of New York, a member of the Board of the Associated Colleges of Upper New York, and a member of the board of visitors of the Air University, United States Air Force. He was president of the Brooklyn Chamber of Commerce and chairman of many drives for charitable and civic purposes. Dr. Rogers was a director of the Intertype Corporation, Namm-Loeser's, Inc., The New York Telephone Company, a trustee of the Brooklyn Savings Bank and Brooklyn Hospital, and chairman of the advisory board of Chemical Bank and Trust Company of Brooklyn. In World War II, he received the President's certificate of merit for service to the War Production Board and other government agencies. Survived by his widow and a son.

John St. Lawrence (1880–1957?), retired assistant works manager, General Electric Co., Erie, Pa., died recently. Born, Hartlepool, England, Dec. 29, 1880. Parents, John and Jane (Walton) St. Lawrence. Education, ME, University of Toronto, 1908. Married Ethel M. Brock, 1910. Mem. ASME, 1917; Fellow ASME, 1949. He was one of the founders of the Erie Section of the Society. Mr. St. Lawrence was associated with the General Electric Co. for nearly 34 years. During that period he distinguished himself by selecting and training a corps of capable assistants, by providing manufacturing-engineering direction to his associates, enabling them to design suitable buildings, select equipment, provide facilities, and train an organization to handle more than 15,000 employees as the plant expanded. During World War II, Mr. St. Lawrence's accomplishments were recognized when he was called upon to accept the first E-award made to the General Electric Co. He was also elected to honorary membership in the Navy League. As war demands became more urgent, new manufacturing facilities had to be provided, Mr. St. Lawrence was responsible for the execution of this program. This expansion was completed in record time. The company's contribution to the Navy program was again recognized by a citation to Mr. St. Lawrence for "outstanding service to the U. S. Navy during World War II." After the war and until his retirement in September, 1947, Mr. St. Lawrence was responsible for manufacturing-engineering direction in converting to peacetime production. Survived by his widow, Ethel Brock St. Lawrence, and five children.

Charles A. Waterous (1877–1956), retired vice-president and general manager of Waterous, Ltd., Brantford, Ont., Canada, died Dec. 7, 1956. Born, Brantford, Ont., Canada, April 6, 1877. Parents, Augustus Tripp and Rebecca (Sime) Waterous. Education, BS(ME), McGill University, 1898. Married Alice Lorene Raines, died March 8, 1957. Mem. ASME, 1916. Mr. Waterous had been a long-time member of the Board of Water Commissioners and later of the Public Utilities Commission. He served several years as chairman of each of those commissions. Member of Engineering Institute of Canada.

Victor Wichum (1885–1957), vice-president and secretary, Wyssmont Co., Inc., Long Island City, N. Y., died June 21, 1957. Born, New York, N. Y., Sept. 11, 1885. Parents, Victor and Ida Marguerite (Beisiegel) Wichum. Education, Pratt Institute, 1906; Brooklyn Polytechnic Institute, 1911; Massachusetts Institute of Technology. Married Edna Marie Schelpert, 1916. Assoc-Mem. ASME, 1916; Mem. ASME, 1935. Mr. Wichum was the author of numerous short articles for textile, rubber, and paper trade publications. Served the Society as a member of the Process Industries Division, and for many years was active in planning the social activities for the Annual Meeting. Survived by his widow and two daughters.

George Bingham Willcox (1872–1957), president and general manager, Willcox Engineering Co., Saginaw, Mich., died April 16, 1957. Born, Centralia, Ill., July 4, 1872. Parents, Lyman George and Azubah (Bingham) Willcox. Education, BS(ME), University of Michigan, 1895. Married Bessie W. Lowe, 1902. Assoc-Mem. ASME, 1895; Mem. ASME, 1908; Fellow ASME, 1946. Held patents on water-weighing and measuring machines; salt plant and automotive equipment. Member of Tau Beta Phi. Author of papers presented before meetings of the Society. Mr. Willcox was also active in civic affairs and was a former president of the board of education in Saginaw, Mich. Mr. Willcox had for many years solicited patents and assisted inventors. His firm had been engaged in patent services and selling equipment for manufacturers of salt.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

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POSITION TITLE | NATURE OF WORK DONE

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NAME OF EMPLOYER (Give name in full) | Division, if any

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EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

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☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
☐ J—Metals Engineering
☐ K—Heat Transfer
☐ L—Process Industries
☐ M—Production Engineering
☐ N—Machine Design
☐ O—Lubrication
☐ P—Petroleum
☐ Q—Nuclear Engineering
☐ R—Railroad
☐ S—Power
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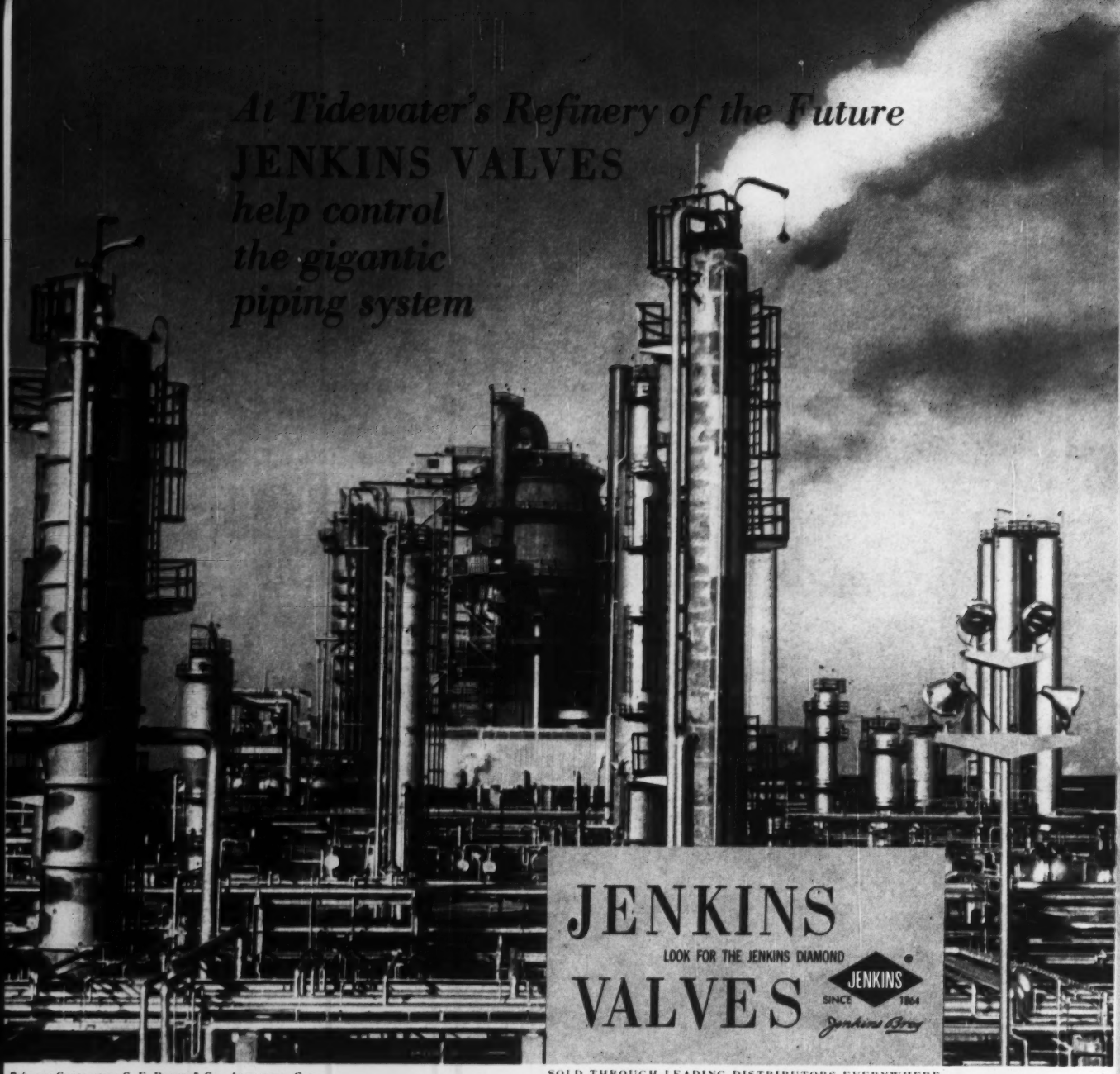
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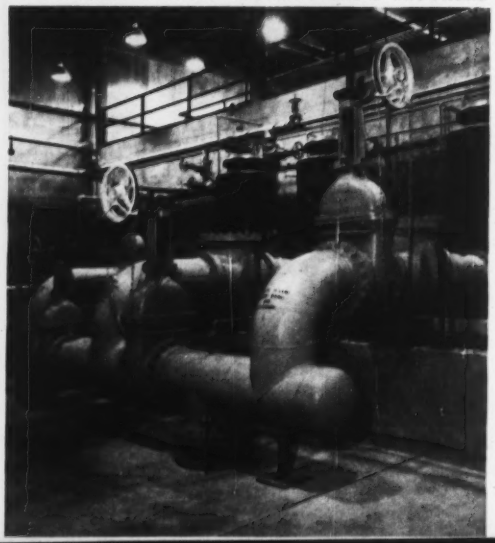
It will pay you to have the same important assurance when you specify or install valves . . . especially since Jenkins Valves cost no more. Jenkins Bros., 100 Park Avenue, New York 17.



These large valves made of Ni-Resist metal are among the thousands of Jenkins Valves in this great refinery. Sizes range from ¼" to 24"; made of various metals to suit different services.

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BUSINESS NOTES
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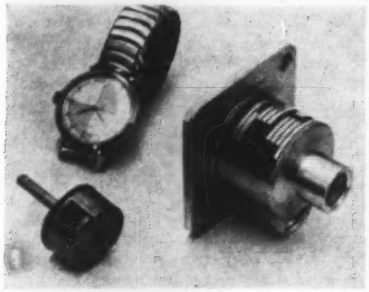


Vane Pump Cartridge

Vickers, Inc., Detroit 32, announces a miniature vane pump cartridge that will deliver 1.04 gpm at 1000 psi and 10,000 rpm, an output of 0.6 hp. It is less than $1^1/_8$ in. in diam, and weighs 2.5 oz.

The cartridge can be manifolded effectively with servo valves, miniature piston hydraulic motors, and fhp electric motors, the firm states. Suggested uses include small radar drives, small computer drives, electronic cooling, fuel pumps, missile skin cooling, flow dividers, pressure lubrication.

Tape Recording System

A Series 3000 multi-channel magnetic tape recording system featuring a 300 kc band width is being manufactured by Recordata Div., American Electronics, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif.

The new system accommodates reel sizes up to 14 in. as standard equipment and may be ordered to utilize 19 in. reels. A single switch on the front panel selects any of six standard speeds up to 60 ips.

Tape transports are available which accommodate $^1/_4$, $^1/_2$, or 1 in. tape. Tape guides may be interchanged, the company reports. Backlighted control buttons, on the primary panel face, control high-speed fast-forward and rewind functions, record, playback and stop operations.

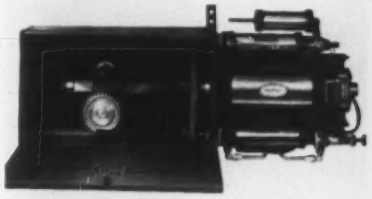
Module housings provide plug-in facilities for record and playback amplifiers. By plugging the proper modules, instant selection of Direct FM or PDM recording or playback in any combination can be achieved.

Bearing Material

A new bearing material, called Chemloy, has been announced by Crane Packing Co., Dept. MXN, 6400 Oakton St., Morton Grove, Ill. It is especially recommended by the company for dry bearing services, both sliding and rotating at temperatures up to 500 F.

The firm says the material is ideal for use with solvents, such as acetone and practically all types of corrosives, and for applications subject to impact, since it will not permanently deform due to shock.

The material has a static or kinetic coefficient of friction against polished steel of 0.04 and a pv factor up to 10,000. It will withstand speeds up to 1000 fpm and loads to 100 psi.



Power Feed Unit

A heavy duty power feed unit, trade named Hy-Torque has been announced by Bellows Co., Akron 9, Ohio.

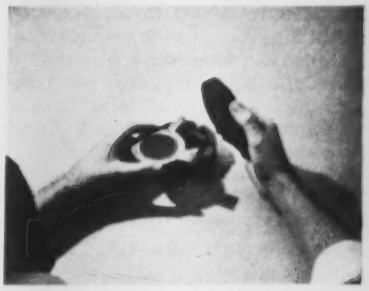
The unit is designed primarily to power the feed on multiple drilling applications. The basic unit consists of a steel gear rack which drives a pinion gear mounted on a shaft with a hub as the drive unit. The 3000 in-lb maximum torque delivered at the hub may be applied to any cross-feed shaft or driven shaft for rotational or linear movement. Four standard models provide a choice of degree of rotation of the 4 in. pitch diameter pinion gear: 170, 255, 340 or 425 deg.

A $4^1/_2$ in. bore air motor advances the gear rack with a thrust of 15 times applied air line pressure. Two of the firm's Hydro-Checks govern the feed rate and serve to balance the hydraulic reaction during the feed portion of the stroke. The unit's hydraulic feed rate is fully adjusted by one control valve which controls the Hydro-Checks. These may be set, by means of adjusting lock nuts to control the feed through the entire stroke, or they may be set to rapid traverse then check or slow rate of speed at any predetermined point, such as the break through point in drilling. Skip and stop checking action is optional in either electrical or pneumatic controls.

Miniature Motor

Western Gear Corp., Electro Products Div., Box 182, Lynwood, Calif., announces the design and manufacture of a miniature 12-16 VDC motor capable of operating in dry nitrogen gas at 30 mm of mercury pressure absolute for 200 hr.

The motor is rated $^1/_{100}$ hp at 10,000 rpm. It draws 2.5 amp at full load and .7 amps no load. It develops 1.00 oz-in. of torque in continuous duty or 1.85 oz-in. intermittent service. Designed for missile application, it measures 1.127 in. in diam and 1.750 in. in length.



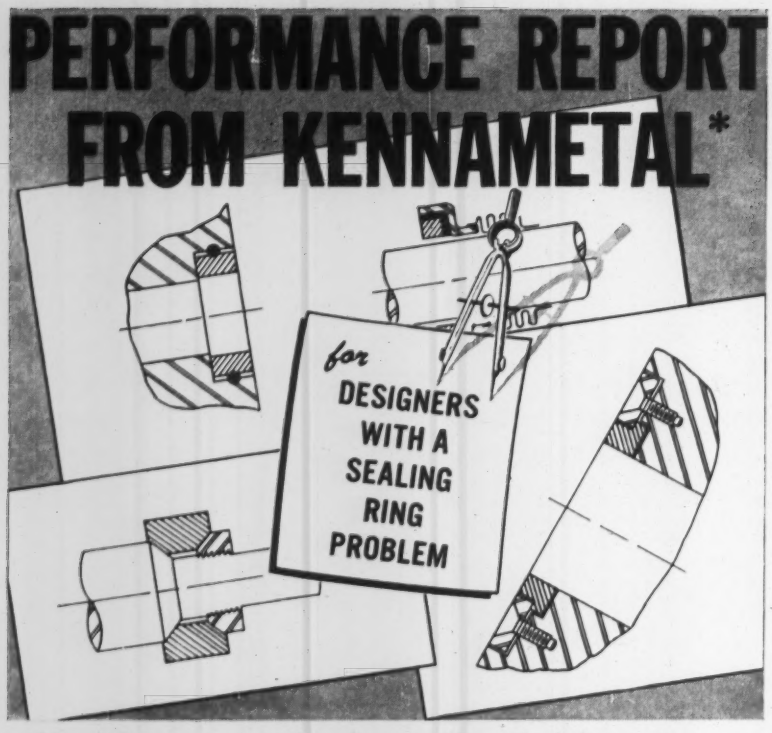
Graphite Burst Disk

Delanium Graphite Co., Elizabeth, N. J., North American distributors for Powell Duffryn Carbon Products Ltd., Hayes, England, has announced availability of a new high quality graphite burst disk for process pressure vessels.

Mounted in a special carbon holder, the disks are said to be easily replaceable and are accurate to ±5 per cent of rated burst pressure. Sizes now in production range from 2 to 6 in. with ratings from 5 to 75 psig.

Operating pressures can be maintained indefinitely up to 75 per cent of rated pressure, and the unit is available with a graphite support bar for vacuum applications.

PERFORMANCE REPORT FROM KENNAMETAL*



If you have any sealing ring problem that demands . . .

1. **Extreme resistance to abrasion, or**
2. **The ability to resist elevated temperatures, or**
3. **Unusual resistance to severe corrosion.**

KENNAMETAL has some proven answers for you.

ABRASION RESISTANCE. Kennametal tungsten carbide sealing rings installed in a deep-well rotary pump gave one to two years' service; packing type seals had failed in two to four weeks. Kennametal rings in a recirculating pump, handling water with fine grains of iron oxide, lasted 30 to 60 *days*. Packing type seals failed in 24 to 48 *hours*.

ELEVATED TEMPERATURES. A jet engine shaft seal of Kentanium,* a titanium carbide, operating without lubrication at 15,000 surface feet per minute under 0.3 to 0.6 lbs. pressure per lineal inch of circumference and 900° to 1000° F, outperformed every other material. Kentanium Rings are stress-free—do not tend to split radially, maintain original face flatness even at high temperatures, and have exceptional wear and resistance strength.

SEVERE CORROSION. Where corrosion and abrasion are present, Kennametal has seal rings of Grade K501, a platinum-bonded carbide. Used as seals to confine liquid oxygen or fuming nitric acid, sealing results are reported as "far superior to any previously used materials, with no indication of face wear."

Other desirable characteristics of Kennametal seals: high modulus of elasticity, low expansion under heat, high resistance to wear and much lower service cost. For more information, ask for "Characteristics" book, write KENNAMETAL INC., Latrobe, Pennsylvania, Dept. DM1.

*Kennametal and Kentanium are the trademarks of a series of hard carbide alloys of tungsten, tungsten-titanium and tantalum. C-3070

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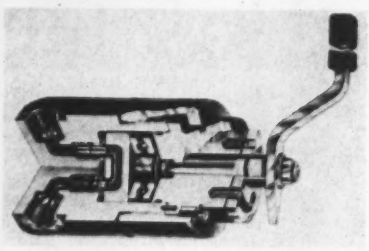

Four-Way Valve

Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, announces a new four-way valve series in pipe sizes from 1/4 to 1 in. It may also be obtained with tube, AND 10050, or any preferred special high pressure connection, the firm states.

It will withstand surges of up to 15,000 psi without damage to the valve's sealing qualities. It is designed for a burst pressure of 30,000 psi.

The Shear-Seal design of this valve represents what is said to be a highly successful principle of extreme pressure control. Lapped optically flat metal to metal sealing surfaces of the sealing rings and mating rotor face always maintain intimate contact; flow travels only through the center of the seal, never across sealing surfaces, the company explains.

Field Test Set

Norden-Ketay Corp., Commerce Rd., Stamford, Conn., announces a test set for flight line testing of aircraft pressure instruments and systems.

This set simulates two types of temperature probes and generates selected pitot and static pressures facilitating flight line checking of altimeters, Mach meters, airspeed indicators and true airspeed computers.

The completely self-contained set weighs 85 lb. It is fully automatic, and can be operated by unskilled personnel, the firm reports.

It has a range of 100 to 1000 knots and −1000 feet to +80,000 feet. Its accuracy is rated at ±1 per cent airspeed; ±1 per cent or ±35 ft altitude, and power is 115 v, 60 cps.

Double Pumps

Gerotor May Corp., Owings Mills, Md., announces the addition of a new line of double pumps for hydraulic oil service.

Capacities of each cartridge section range from 3 to 18 gpm or any combination of these volumes. Speeds of 1200 and 1800 rpm and pressures up to 2000 psi are provided. The units are available with either base or flange mounting and with or without panel mounted valve combinations.

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BUSINESS NOTES
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Desuperheater

A new variable-orifice desuperheater, has been announced by Copes-Vulcan Div., Blaw-Knox Co., Erie 4, Pa.

According to the company, tests over load range of 50 to 1 show that reduced steam temperature can be held constant to meet rigid quality demands only 20 ft downstream from the desuperheater outlet.

The firm says a long run of piping is not needed to mix cooling water intimately with steam. The unit does not have spray nozzles, traps, glands or stuffing boxes and atomizing steam is not needed, it is reported.

The desuperheater consists of a section of steel pipe enclosing a self-regulating orifice extending around 360 deg and a weighted ball held in concentric position by Inconel springs. Cooling water, under the control of a diaphragm-operated valve responsive to a temperature controller, enters the orifice chamber at a uniform rate of flow around the full 360-deg periphery.

In operation, the force of the steam flowing through the desuperheater raises the ball an amount determined by weight of the ball and amount of steam flow. Each rate of steam flow gives the ball a different position, with a practically-constant pressure drop—normally 3 to 4 psig—for all flows.

Cooling water enters the steam at the seat of the orifice, the point of highest pressure drop. With the ball held in concentric position by the springs, the incoming steam flows uniformly around the periphery through which the cooling water is introduced. Introduction of cooling water is further aided by the aspirating effect created by pressure drop in the steam passing through the annular restriction between the ball and ring, the company explains.

The firm says the result is high turbulence regardless of rate of flow, with instant and intimate mixing of cooling water into the steam for complete vaporization. Since the desuperheater body is always mounted vertically, water not immediately absorbed remains in suspension until completely dissipated.

Using a standard temperature controller with both proportional and reset features, the desuperheater holds final temperature within ±5 F. Final temperature may be as low as 10 F above saturation temperature. The new desuperheater is available for pipe line sizes from 2 to 14 in. and for pressures up to 2500 psig. Range of control is limited only by the ability of the cooling water control valve to modulate on light flows, and a 50-to-1 turndown is commonly achieved, the company says.

LISTEN TO YOUR HEART

AND GIVE A LITTLE MORE

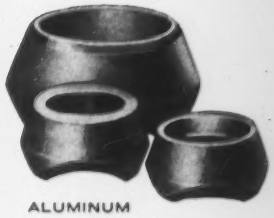
DROP FORGED ALUMINUM WELDING PIPE FITTINGS

5200 SOCKOLETS were used on this pipe fabrication contract—one of the seventy headers is shown below. Note uniformity, strength and ruggedness of this drop forged fitting at the critical branch connection.

LOW COST—the pipe fabricator who was awarded this job was the one whose bid was based on using Bonney Sockolets.

If you use aluminum pipe,
SPECIFY and USE

BONNEY ALUMINUM



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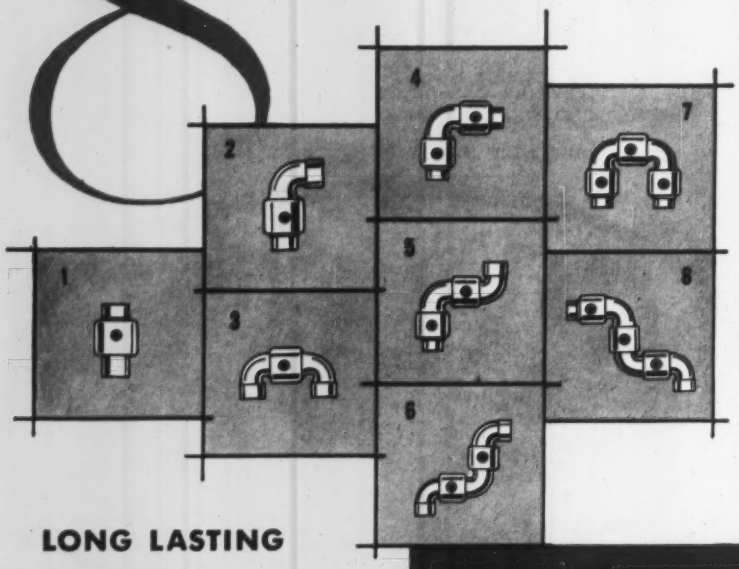
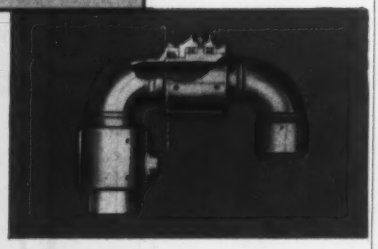


LONG LASTING CONTINENTAL-EMSCO SWIVEL JOINTS



Continental-Emsco Swivel Joints are manufactured in all popular sizes for practically every type of service; from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°. You can service a Continental-Emsco Swivel Joint without removing it from the line. Just break the joint as you would a pipe union. Packing is then readily accessible and can be replaced when necessary. No expensive returns to factory for repair.

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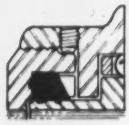

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Rectifier Power Supplies

Walker Div., Norma-Hoffmann Bearings Corp., Stamford, Conn., has completed development of a line of oil filled silicon rectifier power supplies.

The power supply is available in the following capacities: 50, 100, 150, 200, 250, 400 and 500 kw, with input voltages up to 4160 v, output up to 250 v d-c and with approximately 95 per cent efficiency, voltage regulation is 5 per cent or better. Measuring 90 × 72 × 44 in., the rectifier is cased in a sheet steel cabinet, is oil and water tight and features sealed silicon junctions.

New Silicone Rubber

A silicone rubber said to be strong enough to replace organic rubber in many applications has been added to the standard product line of the Silicone Products Dept., General Electric Co., Waterford, N. Y.

Designated SE-555, this compound is now available in commercial quantities. Possessing unusual physical strength, low moisture absorption and good oil resistance, SE-555 is suited for aircraft seals and gaskets for use in the −150 to 500 F range, the company says.

Typical physical properties include 1600 psi tensile strength; 650 to 850 per cent elongation; and 200 to 250 lb-in. tear strength. The material meets or surpasses AMS 3345 requirements for tensile and tear strength, elongation, dry heat resistance, compression set, and low temperature flexibility, it is stated.

The material may be fabricated and cured by all conventional methods of handling silicone rubber. It may be molded in thick section components or extruded with wall thicknesses of 10 mils and less. Typical applications include boots and bellows, forming blankets, and various seals for firewalls, bomb bay doors, wheel and camera wells, hatches, windows and canopies, the company says.

WATCH THE HUMPS IF YOU SCORCH

Back in 1907, speed limit laws were often arbitrarily severe, even if enforcement was apt to be haphazard. The usual limits were 8 miles in town, 15 miles in the country. Those who liked to speed were called "scorchers." To put a damper on the activities of these gay blades, some towns installed sharp ridges or "humps" several inches high across their streets, at regular intervals. If a motorist was foolish enough to run over one of these "humps" at 20 or 30 miles an hour, he was likely to suffer a couple of blown tires or broken springs, as well as considerable discomfort.

Fifty years ago when our founders started in making gears people firmly believed "haste makes waste." Today our standards of "haste" (and "scorching") have changed, at least in degree, but there is still truth in this saying. It particularly applies in making important decisions — such as where to buy your custom gears. A lot of people who have given the matter careful attention come to us for the *best* custom gears obtainable — because they've found out that it pays in the long run. Try us on your next custom gear order, and we think you'll agree with them.

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Fifty Years of "Gears—Good Gears Only"

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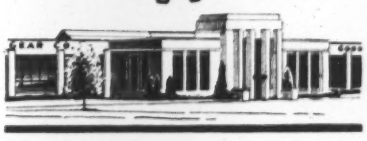

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Self-Lubricating Bearings

What is described as the first commercial application for self-lubricating bearings is announced by the Micro-Precision Div., Micromatic Hone Corp., Box 710, Evanston, Ill.

Now being produced under the trade name of Fabroid, the self-aligning spherical bearings are being used in landing gear door strut sections on several types of military jet aircraft, the company states.

Applications in which these bearings are expected by the company to replace metal bearings include control actuators for ailerons and stabilizers, landing gear actuators, bushings around cylindrical portions of shock absorbers, and helicopter rotor hub parts.

Key to the development of the bearings for the aircraft industry is Teflon tetrafluoroethylene fiber, one of the most slippery materials known, the company says. The chemical composition of this fiber is said to provide the lowest coefficient of friction of any fiber.

The bearing is a composite structure consisting of two fused layers. The bearing face is a weave of Teflon, interwoven on the back with glass fibers, while the back-up layer is a weave of glass fibers impregnated with thermosetting phenolic. These two layers are bonded and cured at elevated pressures and temperatures, resulting in a dense lattice of Teflon fibers facing the bearing surface and intimately supported by interlinked glass-phenolic structure.

When subjected to bearing loads transmitted by the bearing surface, the fiber presents properties differing materially from any known form of the Teflon resin, the company says. For this reason, the bearings are able to support static loads up to 60,000 psi.

Linear Accelerometer

A series of Linear Accelerometers has been announced by Boston Div., Minneapolis-Honeywell, 1400 Soldiers Field Rd., Boston 35, Mass.

Designated Type LA-500 series, the accelerometers are described as true linear, nonpendulous type instruments, inherently insensitive to cross-coupling accelerations. These instruments are available in a variation of ranges from ±1 G to ±60 G and can be provided with two potentiometer pickoffs.

Essentially constant damping is maintained automatically throughout the entire operating range of −65 to +175 F. No warm-up time is required, the firm reports. The combination of constant damping, high performance, small size and ruggedness makes the series suited for aircraft and missile applications where the severe environmental conditions are encountered, the company states.

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Scientifically planned to aid YOU in your work . . . designed to support you comfortably whether you're chewing your pencil or bent over hard at work . . . engineered from the quality materials YOU would recommend, with independently adjustable seat, back and footring to conform to your physique . . . and with removable, replaceable covers in a wide range of fabrics and colors to match YOUR decorating plan.

Pictured, Cramer Hi-Model 4D-22T with forward-tilt seat; others available. All are low-gravity balanced for safe use on casters if desired.

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BUSINESS NOTES
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Flexible Link Shaft

Clark Flexible Link Shaft Co., Box 73, Newton Highlands, Mass., announces a new flexible shaft with equal torque in both directions, unlimited length and equal flexibility in all sizes from 3/8 to 3 in. diam. The shaft is said to be suitable for remote controls and power-drives.

The links consist of trunnion blocks and two half links fastened together with screws or rivets. Cover materials are available in a variety of materials including armored neoprene hose, nonmetallic hose or semirigid tube. End fittings are available to meet given requirements. Minimum link length is three times the diameter and various link lengths can be combined in one shaft using long links for straight runs, the firm reports.

Torque ratings for manual torsional movement are 50 in-lb for 3/8 in. shaft, 200 in-lb for 1/2 in. shaft and 2500 in-lb for 1 1/4 in. shaft. For motor drives at 1750 rpm, 1/8 hp requires 3/8 in. shaft, 1/3 hp requires 1/2 in. shaft and 1 hp requires 3/4 in. shaft.

Rotary Cut-off

As many as 2000 pieces of pipes and tubes ranging in size from 3/8 to 1 1/4 in. OD in light gage to 16-gage wall thickness, can be cut per hour on a new air-operated rotary cut-off machine, according to the manufacturer, Continental Machine Co., 1952 N. Maud Ave., Chicago 14.

The firm says the operator feeds the pipe or tube to a pre-set stop, touches the air valve foot switch and the rotary blade descends at the desired cutting speed cutting the material and leaving a clean, smooth edge.

Rotary cutting is said to provide faster cutting than other methods since its action is through the wall thickness rather than the entire diameter of the material.

Liquid Gear Composition

Whitmore Mfg. Co., Cleveland 4, Ohio, is now packaging its liquid gear composition in a 16-oz push-button aerosol container for lubrication of open gears and sliding surfaces.

A film of Handi-Lube is sprayed on pressure side of surface from a distance of 12 to 18 in. This is designed to eliminate harmful metal-to-metal contact and increase gear life by putting the wear on the lubricant instead of the metal. The lubricants are weatherproof and will not break down even after prolonged use under water, the company states.

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Vertical Immersion Pump

Deming Co., Salem, Ohio, has in production a new line of vertical (immersion type) circulating pumps.

The pump is designed for use in air conditioning, cooling and heating circulation systems, brine pumping, and for circulation systems in commercial laundry equipment, industrial part washers, and other process equipment.

The new Fig. No. 4310 pump is a short setting model with the liquid end of the pump immersed in the pumped liquid. This keeps it primed at all times, the firm says.

The new pump is said to be leakproof and to require no liquid seal or stuffing box. It circulates up to 500 gpm against heads up to 100 ft. The pump is available in 1-, $1^1/_2$-, 2- and 3-in. sizes for 1750 or 3500 rpm. Construction features include a graphite impregnated steady bearing, stainless steel pump shaft, and optional bronze impeller.

Safety Valves

A series of top-guided, bronze pop safety valves have been developed by Farris Engineering Corp., 612 Commercial Ave., Palisades Park, N. J. for steam generator service and air or gas applications at set pressures up to 300 lb at 450 F.

The valves are ASME approved for power boiler and unifired P V codes. According to the company, the new 1875 series offers minimum inlet pipe size with maximum pressure capacity and low cost. Extra-long top guiding is said to give safe, positive protection. Other features include optically machined and lapped flat seat and self-aligning disk for tightness and positive shutoff. Three styles of valves are in the line: 1875 with plain cap; 1875-OL with open lever and 1875-PKS with packed cap and lever. Sizes range from $^1/_2$ to 3 in., male inlet, female side outlet.

Shaft Mounted Drive

Falk Corp., Dept. 255, 3001 W. Canal St., Milwaukee 1, Wis., has announced production of a new, large capacity shaft mounted drive, No. 315J, available in single reduction ratio of 5:1 and in two double reduction ratios of 14:1 or 25:1.

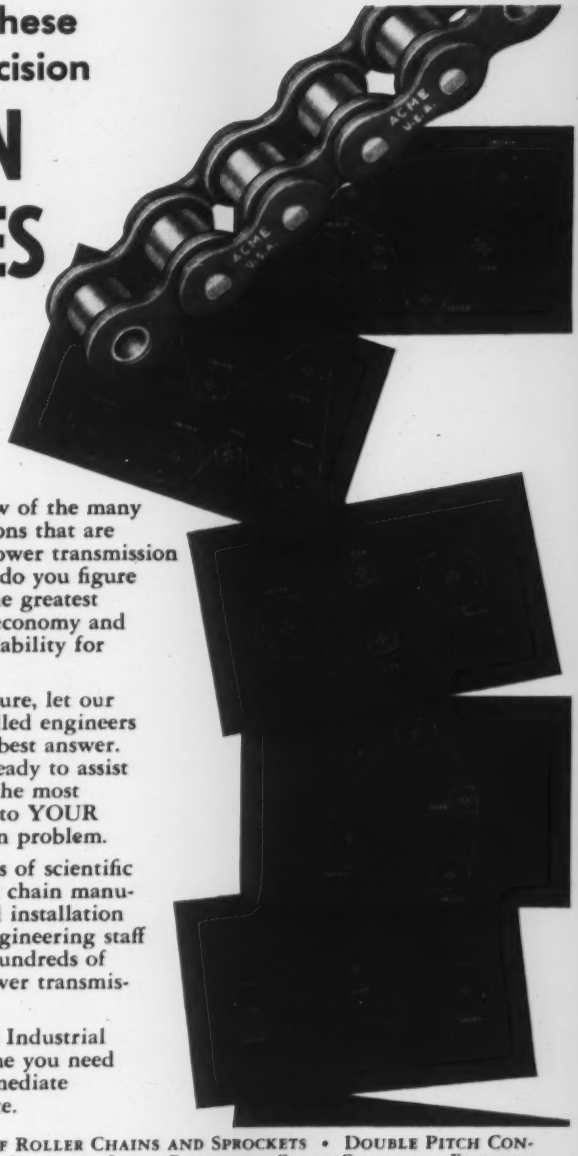
Unit ratings range from 2 hp at 5 rpm to 50 hp at 359 rpm; maximum torque rating at low speed shaft is 31,000 lb-in.

According to the company, a longer center distance between shafts permits use of larger sheaves on installations where unit is mounted with input shaft toward driven machine or on through-shaft applications. Inspection covers on the 3-wall one-piece all steel housing are provided for inspection of bearings and helical gears. An automotive type dip stick is provided for checking the oil level.

Which of these ACME Precision

CHAIN DRIVES

will help you drive it better?



Here are just a few of the many chain drive positions that are unsurpassed for power transmission efficiency. Which do you figure would give you the greatest efficiency, lowest economy and longer-life dependability for your application?

To be absolutely sure, let our staff of highly skilled engineers help you find the best answer. They are always ready to assist you in obtaining the most desirable solution to YOUR power transmission problem.

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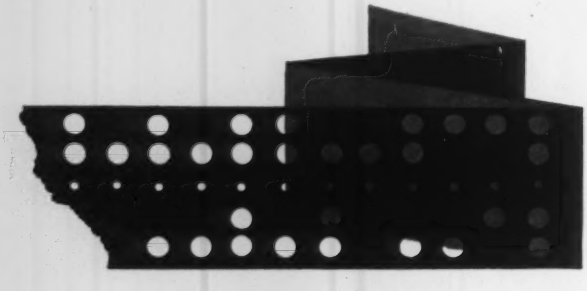

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If you qualify for any phase of computer research, design, or application, we invite you to contact the Manager of Engineering Industrial Relations, Northrop Division, Northrop Aircraft, Inc., ORegon 8-9111, Ext. 1893, or write to: 1041 East Broadway, Dept. 4600-O, Hawthorne, Calif.

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Grease Cups

Visiball Mfg. Co., Box 7021, Ft. Worth, Tex., announces automatic grease cups to replace existing grease fittings, grease cups and other lubricating devices to eliminate human judgement which can result in burned out machinery or over-greasing.

The heart of the new cup is a neoprene disk which can be inflated into a ball, holding up to 2 oz of grease. The disk or ball is filled with a standard grease gun through a fitting on the side of the chrome plated zinc alloy housing. Protecting the neoprene ball is a clear lucite plastic cylinder, through which the maintenance man can see the ball as it fills with grease.

As the bearing uses grease, the ball deflates, indicating the quantity of grease remaining. It is not necessary to refill the cup with grease until the neoprene disk returns to the deflated position, the firm states.

Because of the compression of the neoprene ball and the vacuum created by the motion of the shaft, grease is fed automatically into the bearing only as it is needed.

Plug Valves

New sizes in plug valves for wider application are now available from Circle Seal Products Co., 2181 E. Foothill Blvd., Pasadena, Calif.

The design features include dead tight shut off through use of O-ring flow seal and O-rings at top and bottom to prevent external leakage. In the open position, the valve is full ported and allows a straight-through flow passage.

The valves are operated by handles that open and close against pressure with absolutely no effort. The company claims they are available in pipe sizes 1/4, 1/2 and 3/4 in. The 1/4 in. size is available in stainless steel with a new aluminum handle. Other sizes are available in brass.

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Magnetic Telemetering

A line of Glennite low voltage a-c, d-c power supplies are announced by Engineered Magnetics, Hawthorne, Calif., Div. Gulton Industries, Inc., Metuchen, N. J.

Engineered to deliver precise plate voltages to aircraft electronic systems, the telemeter and strain gage power supplies are designed for 400 cycle operation, but are also available for 60 cycle circuits. Hermetically sealed, the tubeless power supplies have no moving parts nor is a fuse required since they are self-protected for shorted output, the company reports.

Characteristics include a regulation of ±0.2 per cent, ripple of 1 per cent rms, recovery time of 0.5 sec, and a variety of outputs.

Hollow Shaft Gearmotors

A new line of hollow shaft gearmotors, designed to take advantage of the high load capacity in small center distances of double-enveloping worm gearing, is now available from Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

By combining double-enveloping worm gearing with a helical primary, the new gearmotors provide high output torque ratings, extremely compact housings and a cost below that of competitive units of this type, the company declares.

To complement the high load-carrying capacity of the units, extremely large taper roller bearings are used on all shafts.

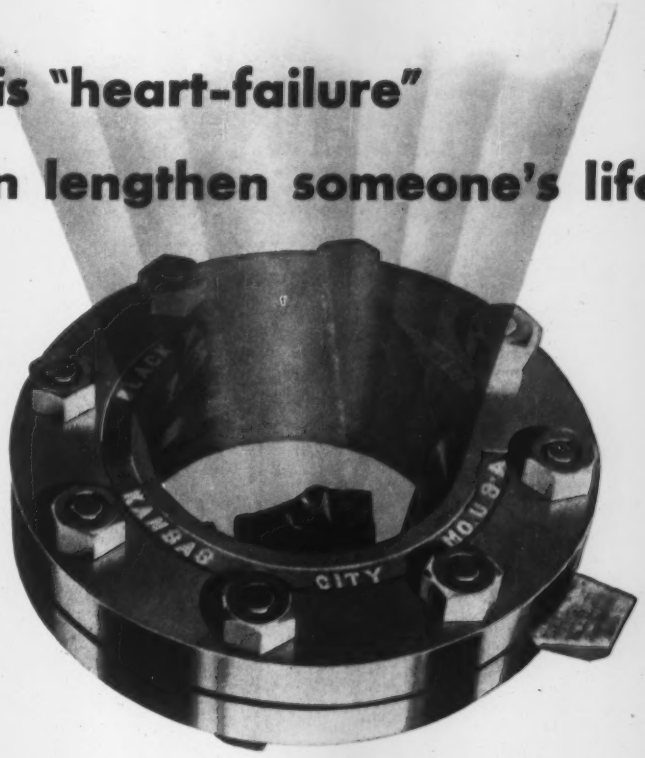
Hollow shaft mounting permits driving of shafts in any position with a floating power unit. A simple torque arm ties the gearmotor down. The gearmotors are currently available to handle 1-hp to 15-hp standard NEMA D-flange motors. They can be ordered with or without motors as desired.

Output speeds range from 7.3 rpm to 525 rpm in 27 increments with 1750 rpm motors. Variations from these standard speeds can be obtained.

The gearmotors are double-reduction units with a helical primary and double-enveloping worm gear secondary. The firm says load-carrying capacities are higher than those obtained from cylindrical worm gearing because of the unique "hour glass" worm that meshes with a throated gear. The two gears, in effect, wrap around each other.

All teeth in both gears are straight-sided and tangent to a common circle, and in contact the full depth of the teeth. One-eighth of the gear teeth are always in mesh and the resulting high area contact between worm and gear teeth spreads unit loads over a greater area. This feature, in addition to providing high load capacity, contributes to the operation, resistance to shock loads, and compactness of the gearmotors, the company reports.

This "heart-failure" can lengthen someone's life!



Pictured above is what happens when a pressure vessel protected by a BS&B Safety Head develops pressures above safe limits. "Heart" of the Safety Head is the rupture disc, which bursts to relieve the overpressure instantly and completely—guarding against injuries to personnel and damage to plant equipment.

BS&B Safety Heads

protect pressure systems in every type industry

Thousands of BS&B Safety Heads are today protecting millions of dollars worth of property and equipment and countless human lives. There's a BS&B Safety Head suitable for many types of pressure systems containing air, gas, steam or liquid.

BS&B Rupture Disc—"Heart" of the Safety Head

BS&B rupture discs are designed to relieve pressures at any specified point from 3 to 100,000 pounds per square inch. They are available in standard sizes ranging from ¼ inch to 36 inches in diameter, and in special sizes and types for virtually any application.

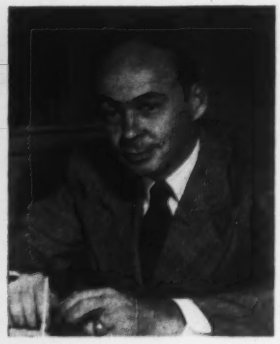
If you use any type of pressured system, let us tell you more about BS&B Safety Heads and rupture discs. Call or write your nearest BS&B office or representative—or write to . . .

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, Dept. 2-FQ10
7500 East 12th St.
Kansas City 26, Mo.

MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.



DYNAMIC AND STATIC LOAD RATINGS

Load ratings of MICRO bearings are based on standards established by the Anti-Friction Bearing Manufacturers Association and are the result of extensive tests.

The "life" of an individual bearing is defined as the number of revolutions the bearing makes before the first evidence of fatigue develops. Fatigue, in turn, is a function of bearing load and although other factors, such as contamination and high temperature, affect the life of a bearing, it is assumed that clean bearings running at normal temperatures are being considered.

It is not possible to predict the life of any individual bearing. The problem, therefore, is best approached by a consideration of empirically derived dispersion curves which provide a means of determining bearing life on a probability basis. That is, they permit the average life of a given group of bearings to be accurately specified.

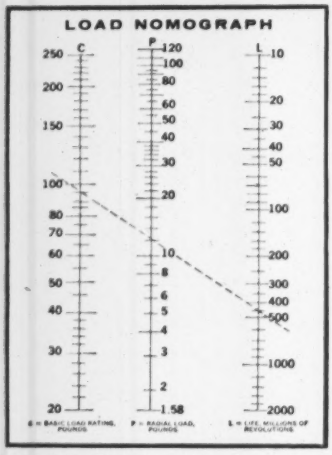
For purposes of standardization, the "rating life" of a group of apparently identical ball bearings is defined as the number of revolutions that 90% of the group will complete or exceed before the first evidence of fatigue develops. This figure is approximately one-fifth of the average life.

If two groups of similar bearings are run under different loads F_1 and F_2 within normal operating range of loading and rpm, their lives L_1 and L_2 are inversely proportional to the cubes of the loads, i.e., The BASIC LOAD RATING C is that radial load which a group of apparently identical bearings can endure for a rating life of one million revolutions, with stationary load and rotating inner ring. Within normal operating ranges, rating life for any load is a constant number of revolutions, so the following relationship, a restatement of the inverse cube proportion, may be used to compute rating life when basic load rating and applied radial load are known:

$$L = \left(\frac{C}{P}\right)^3$$

L = rating life in millions of revolutions
where, C = basic load rating in pounds
P = applied radial load in pounds

The nomograph illustrated permits the quick evaluation of any one of the three quantities when the other two are known. For example, if the C rating of a given bearing is 95 pounds, and the bearing is loaded radially with



12 pounds, P, a straight edge crossing these two values in their respective columns shows that the bearing could be expected to have a life, L, of 450 million revolutions.

"EQUIVALENT LOAD"

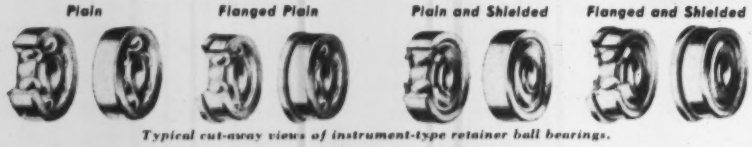
Bearings whose loads are primarily radial are usually also subjected to axial forces. When the axial component of the load is greater than a negligible value, this combined radial and thrust load may be expressed in terms of a simple radial load in order that the basic load rating C may be calculated. This simple radial load is known as the "equivalent load", which is that constant stationary radial load which, if applied to a rotating inner ring, would give the same life as that which the bearing will attain under the actual conditions of load and rotation.

A formula for determining "equivalent load" and a more comprehensive discussion of static and dynamic loads is found in our design handbook.

DESIGN HANDBOOK OFFERED *FREE*

You'll find this new, 70-page authoritative publication a great help in solving problems in designing instruments or small electro-mechanical assemblies.

Write to: New Hampshire Ball Bearings, Inc., Peterborough 1, N.H.



Typical cut-away views of instrument-type retainer ball bearings.

NEW HAMPSHIRE BALL BEARINGS, INC., PETERBOROUGH 1, NEW HAMPSHIRE

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Increment-Start Motors

Brook Motor Corp., 3553 W. Peterson Ave., Chicago 45, Ill., has announced its four-pole motors, 220 v, 1800 rpm, from 20 hp and up, are now available for service requiring an increment-start motor, at the cost of a standard motor.

This is accomplished by use of a standard two-step, three-pole, general purpose starter, with a time delay of two to five seconds between the two steps, the firm says. Special wiring in connecting the delta connected motor is required, which is said to be comparatively simple and a wiring diagram is furnished.

In starting the motor when the first set of contacts closes, one-half of the motor winding is energized and the rotor begins to turn. After this first step with its time lag, the second set of contacts closes and the break down torque is then identical to across the line starting. The second step parallels the remaining one-half of the winding in with the first half, thereby completing the circuit and the rotor quickly attains the full rated rpm.

Dynamometer Control

Electrically-simulated inertia has been substituted for unwieldy inertia disks (flywheels) in a new type of dynamometer control now available from General Electric's Industry Control Dept., Roanoke, Va.

Use of electrically-simulated inertia is said to eliminate the necessity for hoisting huge flywheels into place for the testing of acceleration and deceleration performance of passenger cars, trucks, and buses. Formerly, as many as 24 huge flywheels weighing a total of about 10 tons were required in the testing of heavy truck chassis.

The flywheels were used to simulate the effect of vehicle mass.

The company says the new control provides savings in floor space, initial cost, and time required to set up for a test. Using electrical simulation, it is necessary only to set a potentiometer for the desired inertia value and put the test stand into operation, thereby eliminating the difficult and time-consuming task of setting up bulky flywheels prior to a test.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

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Increased activity in the design and production of system electronics units like the one illustrated above has created openings for engineers in the following areas:

- **ELECTRONIC AND AIR DATA SYSTEMS** Required are men of project engineering capabilities to participate in the design and development of complete electronic control and air data systems for use in current and future high performance aircraft. Also required are development and design engineers with specialized experience in servo-mechanisms, circuit and analog computer design utilizing vacuum tubes, transistors, and magnetic amplifiers.
- **SERVO-MECHANISMS AND ELECTRO-MAGNETICS** Work includes the design and development of magnetic amplifier control devices and integration of components into finished systems. Servo-system analysis and performance prediction would be helpful. Complete working knowledge of electromagnetic theory and familiarity with materials and methods employed in the design of magnetic amplifiers is required.
- **FLIGHT INSTRUMENTS AND TRANSDUCER DEVELOPMENT** Requires engineers capable of analyzing performance during preliminary design and able to prepare proposals and reports. Experience with sensitive aircraft instruments, servos, gyros, auto pilots and flight controls is desirable.
- **FLIGHT INSTRUMENTS DESIGN** Requires engineers skilled with the drafting and design of light mechanisms for production in which low friction, freedom from vibration effects and compensation of thermo expansion are important. These mechanisms frequently involve instruments, bearings, gears, bellows, diaphragms, cams, potentiometers, linkages and small electric motors.
- **HIGH FREQUENCY MOTORS, GENERATORS, CONTROLS** Requires electrical design engineers with BSEE or equivalent interested in high frequency motors, generators and associated controls. Experience in the field of aircraft motors and generators, servo-motors or high speed, high frequency machine tool motors helpful. The field of power supply and utilization equipment on modern aircraft and missiles provides excellent opportunities.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Air Suspension System

Clark Equipment Co., Automotive Div., Buchanan, Mich., has introduced a semi-trailer air suspension system featuring integrated air reservoirs and advanced sway control designs.

The units are available in single axle models of 18,000 and 20,000 lb capacities and tandem models of 32,000 and 36,000 lb capacities. Each is offered in packaged assemblies of frame, air springs, reservoirs, shock absorbers, filters, leveling valves and sway bars for simple installation on new equipment or operating trailers. Interchangeability of parts between single and tandem models is provided.

Air reservoirs are integral parts of the unit. Air is delivered to each reservoir by a common line from the tractor's compressor. Each reservoir in turn serves one side of the air suspension independently of the other. Thus, the firm points out, the trailer bed remains level both laterally and vertically under all load conditions.

Built-in sway bars are provided to minimize lateral roll. Two lower torque arms and an upper torque rod maintain and position the axles laterally and absorb brake torque.

Variable Speed Motor

A new compact, footless Varidrive with NEMA style C or P face-type mounting bracket has been developed by U. S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54. The new variable speed motor, designated Type VEV, is said to feature quick, accurate alignment to the driven equipment.

Castings are normalized under a special heat-seasoning process to remove internal stresses and prevent distortion, the firm states. Lubriflush lubrication is designed to provide longer bearing life and relubrication without disassembly. Windings are asbestos protected.

The unit is available from 1/4 to 30 hp in ratios up to 10:1 and can be furnished with automatic control or remote controls of the mechanical or electrical type.

Storage Bin

Palmer-Shile Co., 12605 Mansfield, Detroit 27, Mich. announces an all-steel storage bin, stacking type, with four-way entrance, designed for use with hand or power lift truck or fork truck.

The unit can be tiered with portable elevator, high lift or fork truck, or it can be built with crane lugs for use with overhead hoist.

Made of heavy steel plate with legs and corner reinforcements of angle iron, the bin is top-edge flanged all the way around.

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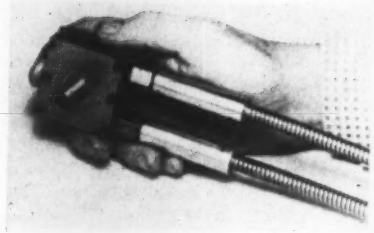
BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS



Positioning Device

Aerotech Specialties, Inc., Glastonbury, Conn., announces a remote-controlled positioner for independent settings of position and angle, said to be particularly adaptable for accurate positioning of probes although it can develop a thrust of 100 lb.

The combination of rotary and linear motion makes it suitable for positioning direction-sensing probes in a fluid stream, the firm states. The probe, up to 1/4 in. maximum diameter, is mounted to project through the hollow lead screw. Linear position (immersion) can be adjusted and measured to .001 in. accuracy, maximum linear traverse speed, 6 in. per minute. The length of traverse can be varied to suit the application by limit stops. Rotation can be measured to 0.1 deg, unlimited rotation in either direction with a maximum speed of 1.5 revolutions per minute, the company reports.

The actuator has no electrical components and has sealed grease lubrication. The mounting adapter can be varied to suit the application, the company says. Drive is through flexible cables from a motor box approximately 10 ft away. The motor box contains the motors and selsyns, electric clutches and limit switches.

A combination of adjustable mechanical stops on the lead screw and a torque limited clutch in the motor box prevent over-travel in case of limit switch failure. The motor box is connected to the transmitter by an electric cable which can be over 100 ft long. The transmitter has pushbuttons for speed and direction control and registers position to .001 in. and 0.1 deg. directly on counters driven by selsyns from the motor box.

Ball Bearings

Lubricated-for-life ball bearings utilizing new seals of Teflon are a recent development of Hoover Ball and Bearing Co., Ann Arbor, Mich.

The seals are designed to provide positive line contact between the inner raceway of the bearing and the permanently attached full metal shields. Sealing action is so effective that the lube, applied at the time of bearing assembly, can be expected to last as long as the bearing itself, the company states. The seals also act as a slinger to improve lube circulation.

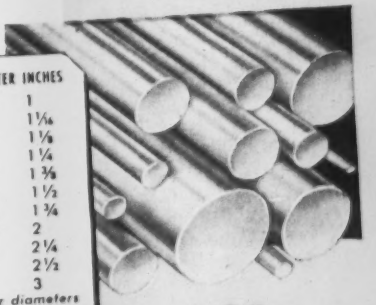
Teflon*...

Your Best Source Is JOHN CRANE

Thickness Inches	Nominal Size
1/16	12 x 12
3/32	18 x 18
1/8	24 x 24
3/16	36 x 36*
1/4	48 x 48*
3/8	
1/2 & Up	

* Can be furnished in 1/2 sheets

SHEET



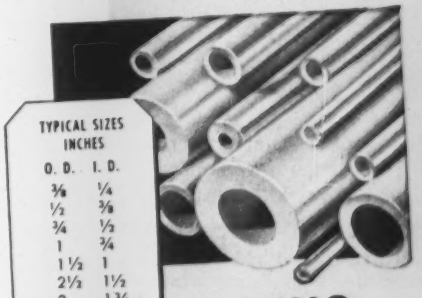
DIAMETER INCHES	
1/4	1
5/16	1 1/16
3/8	1 1/8
7/16	1 1/4
1/2	1 3/8
9/16	1 1/2
5/8	1 3/4
3/4	2
7/8	2 1/4
	2 1/2
	3

Other diameters on specification

ROD

HERE'S WHY: You can order in quantity and in a wide variety of sizes—and be certain of complete uniformity throughout. Our strict density control assures you thoroughly non-porous Teflon—free from any flaws which might possibly affect your end use or product. Dimensions are accurate to your most critical tolerances—no rejects, waste of material or loss of time. You get product purity—Teflon at its best in every one of its remarkable characteristics. Delivery is prompt—you get the quantity you want when you want it.

Since the availability of Teflon, "John Crane" engineers have worked with Industry to successfully solve innumerable problems and develop new applications. *You can benefit from their experience and know-how.*



TYPICAL SIZES INCHES	
O. D.	I. D.
3/8	1/4
1/2	3/8
3/4	1/2
1	3/4
1 1/2	1
2 1/2	1 1/2
3	1 3/4

TUBING

Characteristics of Teflon

CHEMICAL
Completely inert.

ELECTRICAL
Very high dielectric strength. Extremely low power factor.

THERMAL
Temperature range −300° to +500° F.

MECHANICAL
Strong, flexible, weather resistant.

LOW COEFFICIENT OF FRICTION
Absolutely non-stick.

* DuPont Trademark

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JOHN CRANE CRANE PACKING COMPANY

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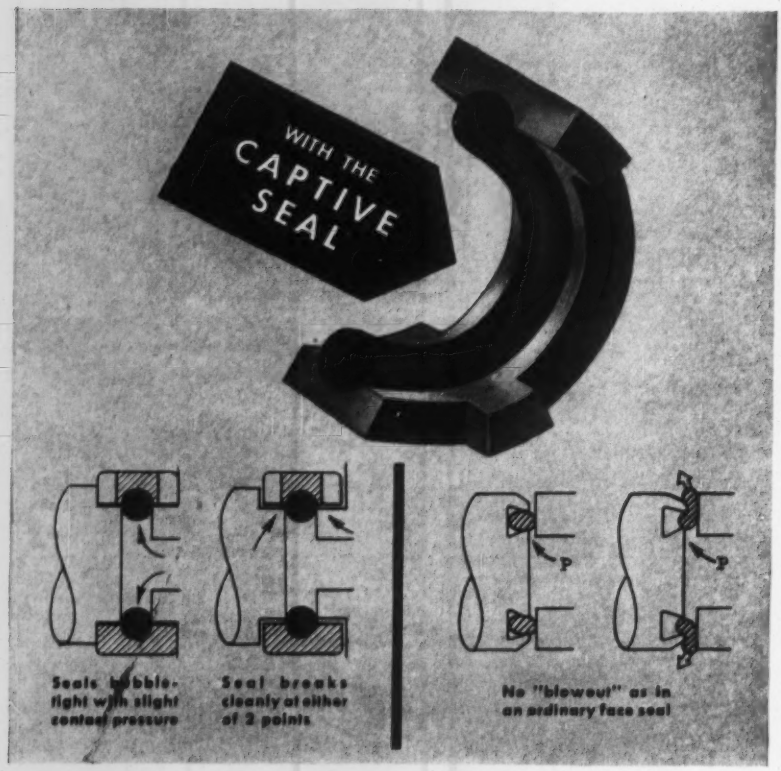
Read the inside story of these **NEW** Aircraft Valves


WITH THE CAPTIVE SEAL
Seals bubble-tight with slight contact pressure
Seal breaks cleanly at either of 2 points
No "blowout" as in an ordinary face seal

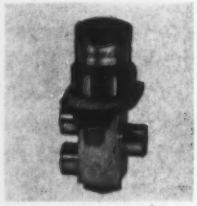
Bridgeport, well-known supplier of aircraft bellows and assemblies, brings you a new sealing principle—the BERGEN CAPTIVE SEAL—and 3 new compact, light-weight valves.

Here is a seal that can't "blow out" because of its steel captor retainer that provides not one, but *two*, breaking points that instantly release pressure unbalance when the seal is broken.

The CAPTIVE SEAL itself does not wear, is not damaged by particles in the fluid stream. And anyone in the field can replace it.

General purpose Solenoid valve. ¼", 3way, 24 V.D.C., 3000 psi. Hydraulic—pneumatic.

Screw socket Solenoid Pilot valve. 3 way, 3000 psi. Pneumatic.



General purpose Solenoid valve. ½", 3 way, 24 V.D.C, 3000 psi. Hydraulic—pneumatic.

Robertshaw-Fulton CONTROLS COMPANY

Write for new catalog containing complete operating and physical data on these and all other Bridgeport aircraft valves and products.

BRIDGEPORT THERMOSTAT DIVISION • MILFORD, CONN.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Tape Data Selector

International Business Machines Corp., 590 Madison Ave., New York 22, announces two new optional features—file search and additional magnetic core storage—now increase the capacity and flexibility of the company's 774 tape data selector.

The basic 774 acts as a translator between magnetic tape units and card-operated machines by providing a punched card image of data recorded on the tape, the firm explains. The type of coding used to record data on magnetic tapes is automatically converted to 12-position punched card code before it enters the magnetic core storage section of the machine. The data is then available in storage as output to initiate punching and comparing operations by IBM accounting machines or the IBM 519 document originating machine.

With the new file search feature, users of the 774 can rapidly locate any individual record or class of records within a file of magnetic tapes, it is stated.

The selector was previously available only with 120 positions of magnetic core storage. With the new expanded capacity users may avail themselves of 120, 140, or 160 positions of storage, depending on the model selected. This additional capacity makes possible the punching and comparing of 80 columns of data with the 519 document originating machine, the company says.

Speed Reduction Pulley

Hart Reduction Pulley Co., 426 W. Main St., Waukesha, Wis., announces a new design in its reduction pulley with internal planetary gearing offering speed reductions up to 8000 to 1, shaft mounted, to provide two internally reduced speeds.

Both of these speeds may be in the same direction or one forward and one reverse, the firm states.

Speeds are controlled by two mechanical clutches mounted on a base and operated by a common lever to provide interlocking operation. According to the company, the lever may also be arranged for operation by hydraulic or air power. Power may be by V-belts of any type and size, or the pulley may be adapted for chain or gear drive.

The new dual-clutch controlled reduction pulley can be operated either horizontally or vertically, is completely sealed, equipped with hardened gears and ball bearings throughout running in oil.

Overload release is provided by means of a roller in the clutch mechanism which rides in an eccentric groove cut in the clutch drum. On overload the clutch drum slips, forcing up the roller and opening the clutch. Pulley then free-wheels. Sizes available include 12, 18, 20 and 24 in. diam with horsepower ratings up to 120.

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New York 18, N.Y.

MECHANICAL ENGINEERING—OCTOBER 1957 Issue

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1	22–23	37	51	63	80	97	107	117	133	147	159TL
2	24	38	52	64	83	98	108L	118	134	148–149	159TR
3	25	39	53	65	84	99	108R	119	135	151	159BR
4–6	26–27	40	54	67	87	100T	109	121	136	153	160
6–7	28	41	55	70	90	100B	110L	123	137	155	175
8–13	29	42	56	72	92	101	111	125	139	156L	177
14	30–31	43	57	73	93	102L	112T	126	141	156TR	178
15	32	44–45	58	74	96T	103	112B	127	142	156BR	IBC
16–17	33	46	59	75L	96B	104L	113	129	143	157L	OBC
18–19	34	47	60	75R	98T	104R	114L	130	144	157R	
20	35	48–49	61	77	98B	105	114R	131	145	158TL	

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2	24	38	52	64	83	98	108L	118	134	148–149	159TR
3	25	39	53	65	84	99	108R	119	135	151	159BR
4–5	26–27	40	54	67	87	100T	109	121	136	153	160
6–7	28	41	55	70	90	100B	110L	123	137	155	175
8–13	29	42	56	72	92	101	111	125	139	156L	177
14	30–31	43	57	73	93	102L	112T	126	141	156TR	178
15	32	44–45	58	74	94T	103	112B	127	142	156BR	IBC
16–17	33	46	59	75L	94B	104L	113	129	143	157L	OBC
18–19	34	47	60	75R	95T	104R	114L	130	144	157R	
20	35	48–49	61	77	95B	105	114R	131	145	158TL	

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BUSINESS NOTES
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Diesel Fuel Filter

A new secondary fuel filter element for use on diesel engines in nearly every high-power diesel application has been introduced by Alco Products, Inc., Schenectady 5, N. Y.

Incorporated in the new filter element is a filtration area 13 per cent greater than in the firm's previous standard unit. The element sells for less than one-third the cost of the former standard.

Pleated design of a new high-quality filtering paper, coupled with improved manufacturing techniques resulting from the use of improved stamping dies, has been proved in laboratory tests with units submitted by various independent filtration specialists, the company reports.

High-Strength Studs

Special high-strength studs for power-plant steam turbines, nuclear-reactor equipment and other high-temperature, high-pressure fastening jobs are now available as a customer-engineered product line from Standard Pressed Steel Co., Jenkintown, Pa.

The custom-engineered studs range in size from $\frac{1}{2}$ to 6 in. in diam and from 6 to 72 in. in length. Some weigh as much as 800 lb, the firm reports.

The threaded studs are made from a variety of high-strength, high-temperature and corrosion-resistant alloy steels. They can be supplied with tensile strengths of 220,000 psi or more for moderate temperature applications and as high as 170,000 psi for use at temperatures of 900 F.

Union-Ball Valve

What is described as a new concept, combining the function of a union and a ball valve in one compact unit, has been introduced by Worcester Valve Co., Inc., 20 Parker St., Worcester, Mass.

The union-ball valve is an adaptation of the firm's recently announced ball valve. With the use of this valve, the necessity of installation of a separate union to provide a breaking point in the line is eliminated, the company states. In-line maintenance is said to be possible by the simple expedient of removing four bolts, lifting the center section (which contains all renewable parts) from the line and making replacements.

With the opening in the ball and seat rings maintaining the same shape as the inside of the pipe, resistance to flow is well below that of globe or gate valve and friction is reduced to a minimum, the company says. Operation of the valve is unaffected by reversal of flow, as the ball is fitted with twin seals, one on either side.

The components of the valve may be of bronze, aluminum bronze or aluminum with carbon steel, Type 303 stainless steel and Type 316 stainless steel will be available. Seat and seal materials may be of Buna-N, hypalon, neoprene, natural rubber or Teflon.

To show fluid volume, photographer Bernard Hoffman uses the free discharge of water from an ordinary garden hose.

Controlling Volume in Fluid Engineering

Few volume control problems can be solved with a quick twist of your wrist the way you do with a garden hose nozzle. In processing equipment, the factors of pressure, flow, and time must also be carefully considered. That's why, when you need accurate answers, you can depend on the broad engineering background S. Morgan Smith offers.

Take an SMS Rotovalve, for instance. Its full line opening means least head loss, lower pumping costs. Hydraulic imbalance and mechanical design make the Rotovalve easy to operate. Fast initial shut-off limits reversal of flow, and closing can be in one second or as slow as required. Final closure is positive and drop tight throughout valve life. SMS Ball Valves, similar to Rotovalves, offer many of these same advantages.

Information on the complete SMS line – R-S Butterfly Valves, Rotovalves and Ball Valves may be obtained by calling our nearest representative. Or, write S. Morgan Smith Co., York, Pa., for data on standard valves or special, engineered applications.

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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Butterfly Valve

The production of a new line of butterfly valves, said to feature a unique rubber seating principle and unusual operating characteristics, is announced by Darling Valve & Mfg. Co., Williamsport, Pa.

Manufactured under licensing agreement with the designer, Pelton Div., Baldwin-Lima-Hamilton Corp., the new rubber seated valves are trade-named Darling-Pelton.

Advantages claimed for the new butterfly valve include lower operating torque, adjustability of seat for tight shutoff, seat replacement without removal of shaft or operator, elimination of shaft sealing problems as the rubber seat is a continuous ring integral with the disk, and, increased operating cycles before part replacement or maintenance is necessary.

The line extends from 4 to 72 in. sizes for pressures in the 50 to 250 psi range. The valves are designed for all types of manual and air or hydraulic cylinder operation.

Heavy-Duty Rotary Pump

Worthington Corp., Harrison, N. J. announces a heavy-duty rotary pump line.

Available in sizes 1 to 4, the new herringbone gear rotary pump is said to be applicable for oil burner service, high-pressure coolant service, small hydraulic systems, hydraulic lifts, filtration system, and circulation service, and other applications for continuous service at pressures to 500 psi in capacities to 25 gpm.

The new pump has suction and discharge openings from $\frac{1}{2}$ to 1 in., NPT and its construction incorporates few operating parts.

Features of the pump include nodular iron herringbone gears, four force-feed lubricated roller bearings, replaceable steel-backed, bronze wear plates, and single stuffing box available with packing or mechanical seal for minimum leakage.

Hydraulic Accumulators

A line of piston-type accumulators for hydraulic service has been introduced by Industrial Hydraulics Div., Parker-Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

The line includes 14 models ranging in oil capacity from 10 cu in. to 10 gal and four inside diameter sizes ranging from 2 to 7 in. All models are furnished with SAE straight thread connection ports; adapters for other style connections are available. The accumulator can be mounted in any position, the company states.

In addition to functioning as auxiliary or emergency sources of hydraulic power, the accumulators are being used for shock absorption purposes to keep the pressure constant, smooth out the operation and protect the other units in the system from effects of excessive momentary peak surges of pressure, the firm reports.

Punched Card System

A new punched card system designed to increase accuracy and speed of batch weighing by taking formulation out of the hands of the operator has been developed for users of electronic proportioning equipment by Richardson Scale Co., Clifton, N. J.

Integrated with an automatic proportioning panel, the punched card reader system makes use of punch cards which have been previously coded for prescribed batching formulas.

The system starts to function immediately when the operator inserts one of these cards into unit, pulls a lever to lock it in place and presses a start button. From this point, the company states, everything works automatically, with an exact cycling of any number of bulk materials through the various stages of weighing, discharge, mixing and conveying away for bagging.

Continued on Page 90

1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

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Long Range Planning and Research at Marquardt...

by
Roy E. Marquardt
President

Although ramjet development in the Powerplants Division is the major activity here at Marquardt, there are three other divisions carrying on significant work; Controls and Accessories, Test, and Long Range Planning and Research.

The youngest of these Divisions is Long Range Planning and Research. Headed by John Drake, and numbering 50 engineers, the Division has two primary functions:

PLANNING — anticipating product trends in areas where we now operate or might enter. Actually this planning is done in a staff capacity, and normally the results end up as recommendations.

SUPPORT — to the other divisions, by introducing product improvements which offer promise for the future. These improvements generally involve a small scale program to establish the idea as feasible. This research function also may be concerned with areas which do not fit into present Marquardt projects.

Long Range Planning and Research was begun in 1954. One of its first studies concerned areas where the ramjet can now be used or where it might be used in the foreseeable future. To date some exciting new powerplant cycles have been plotted. Some are variations of cycles now in existence, others are radically different.

Projects also have probed new "exotic" fuels, new types of diffusers, accessory systems, and controls. One phase of Aircraft Nuclear Propulsion is now being explored.

Ground was broken near Newhall, California recently for a research test center. This aerodynamic facility will have testing capabilities to Mach 14.5 as a wind tunnel and Mach 10 for free jet testing with excellent simulation of full scale flight conditions (Reynolds Number). In addition, it will permit simulation of combustion conditions to Mach 8 and altitudes above 150,000 feet.

Within this Division, research engineers will find a spectrum of research engineering opportunities, including:

DESIGN	AERO-THERMODYNAMICS
NUCLEONICS	HEAT TRANSFER
CONTROLS	COMBUSTION

For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Dale, Professional Personnel, today.

Roy E Marquardt

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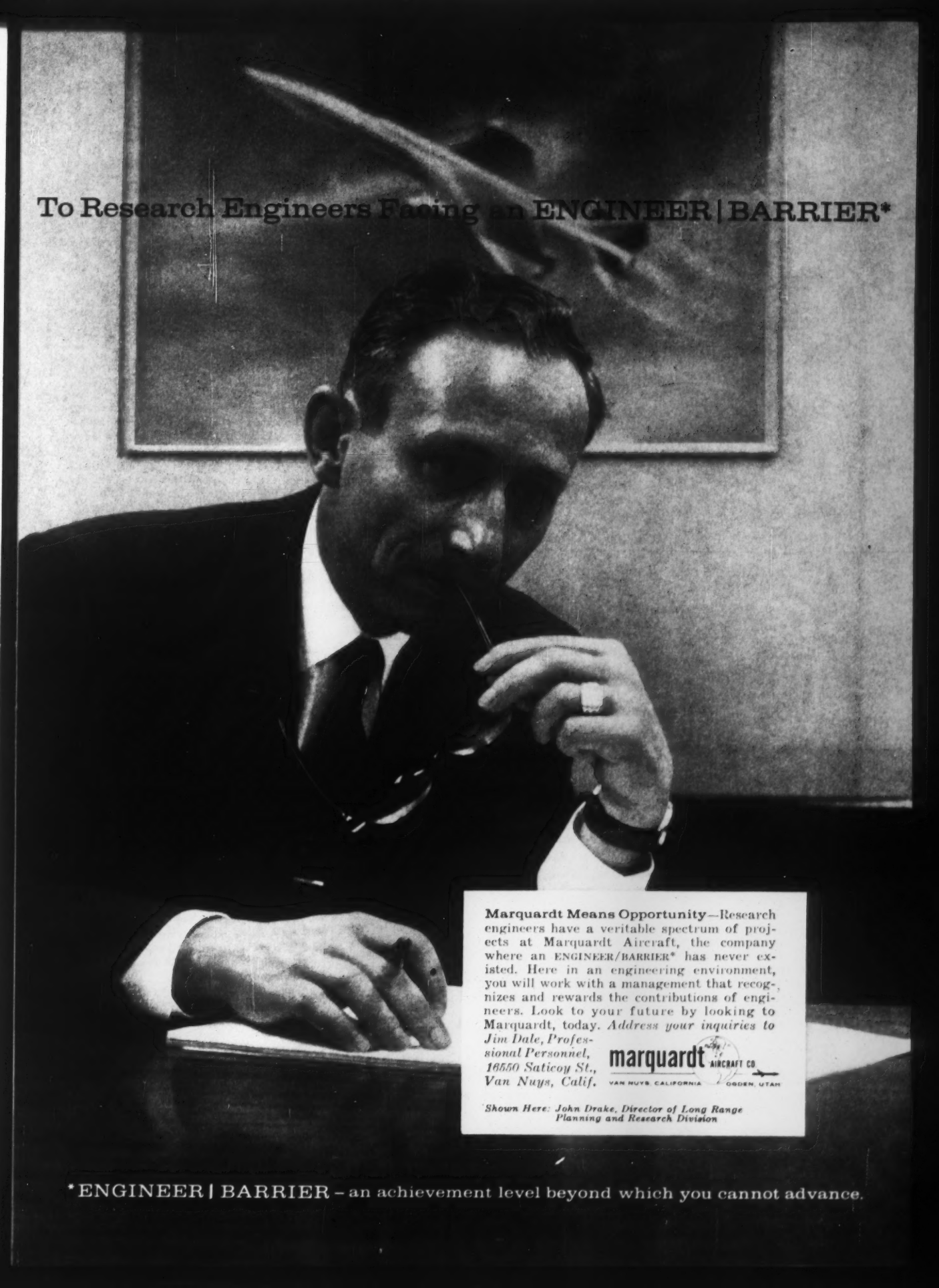
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ROCKFORD

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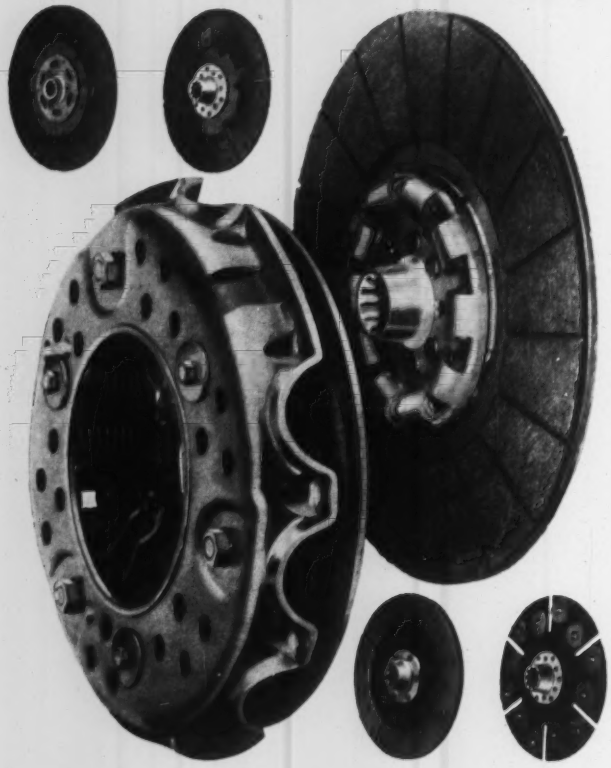

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ENGINEERING B-W PRODUCTION

CLUTCHES

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Vinyl Valves

Lunkenheimer Co., Box 360, Cincinnati, Ohio, announces the addition of valves with socket ends to its line of Luncor PVC valves.

Designated as Fig. 2601, the new socket-end valve is installed in PVC pipe lines by solvent welding. Solvent cements suitable for joining the valve and pipe are available commercially. The valve is rated 125 WP and 140 F.

These money-saving, high-performance valves have been particularly successful in handling most common corrosive solutions in industrial operations, chemical processing, and marine installations. The high strength-weight ratio of Luncor PVC valves gives them rigidity comparable to metal.

For detailed service recommendations, write for a confidential corrosion service information form available from Lunkenheimer distributors, or from the company.

Diesel Engines

A new line of diesel engines, developed for trucks and busses, has been announced by the Detroit Diesel Engine Div., General Motors Corp., 13400 W. Outer Drive, Detroit 28.

The new series, 71-E and 71-T engines, is available to truck and bus manufacturers for installation as original equipment in four and six cylinder models.

According to the company, the engines will power trucks and busses ranging from 26,000 lb gross vehicle weight to 60,000 lb gross vehicle weight and up. The E series has four exhaust valves per cylinder, instead of the conventional two, to insure the expelling of all exhaust gases. Its fuel injectors have a newly designed spray tip which more completely atomizes the fuel for more efficient combustion and to reduce fuel consumption, the firm reports.

An increase of 38 per cent in the cylinder liners' air inlet area is said to result in cooler piston operation and longer engine life. Its newly designed top compression ring, will also add to the piston life and to engine power, the company states. A new high-capacity, low-speed blower, packing more fresh air into the cylinder, is designed for greater engine efficiency.

The four cylinder 71-E has a basic brake horsepower rating of 140-hp at 2100 rpm; the six-cylinder is rated at 210-hp at 2100 rpm. The engines are rated at 1500 ft elevation, at 90 F.

The 71-T series includes a turbo-charger operated by the engine's exhaust gases, which is said to increase net horsepower without additional fuel consumption. Trucks testing this engine in the six cylinder model have increased fuel mileage by as much as 15 per cent. The four cylinder 71-T has a rated horsepower of 171 at 2300 rpm, the six cylinder is rated 236 at 2100 rpm.

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Electronic Speed Control

B & B Co., 3124 E. 14th St., Oakland, Calif., announces a packaged electronic speed control designed for operation of any shunt or compound d-c motor to 1/4 hp from a standard 117 vac power supply.

Designated Model SC-1/4 electronic motor control, the unit is said to provide variable speed from 0 to full motor speed at essentially constant torque, forward or reverse. It will maintain any desired speed uniformly, regardless of line voltage variations as high as 20 per cent.

An adjustable dynamic brake is incorporated in the unit to provide any desired degree of braking. Control system is suitable for remote or automatic operation on special applications.

Armature power is supplied from a NL-710 Thyratron tube rated at 2.5 amp with 30 amp instantaneous peak rating. Grid bias is supplied by a transformer through a rectifier-filter network, eliminating the conventional grid bias battery. Bias voltage is controlled by tandem potentiometers mounted on a single shaft, polarized to add positive voltage as bias voltage is reduced.

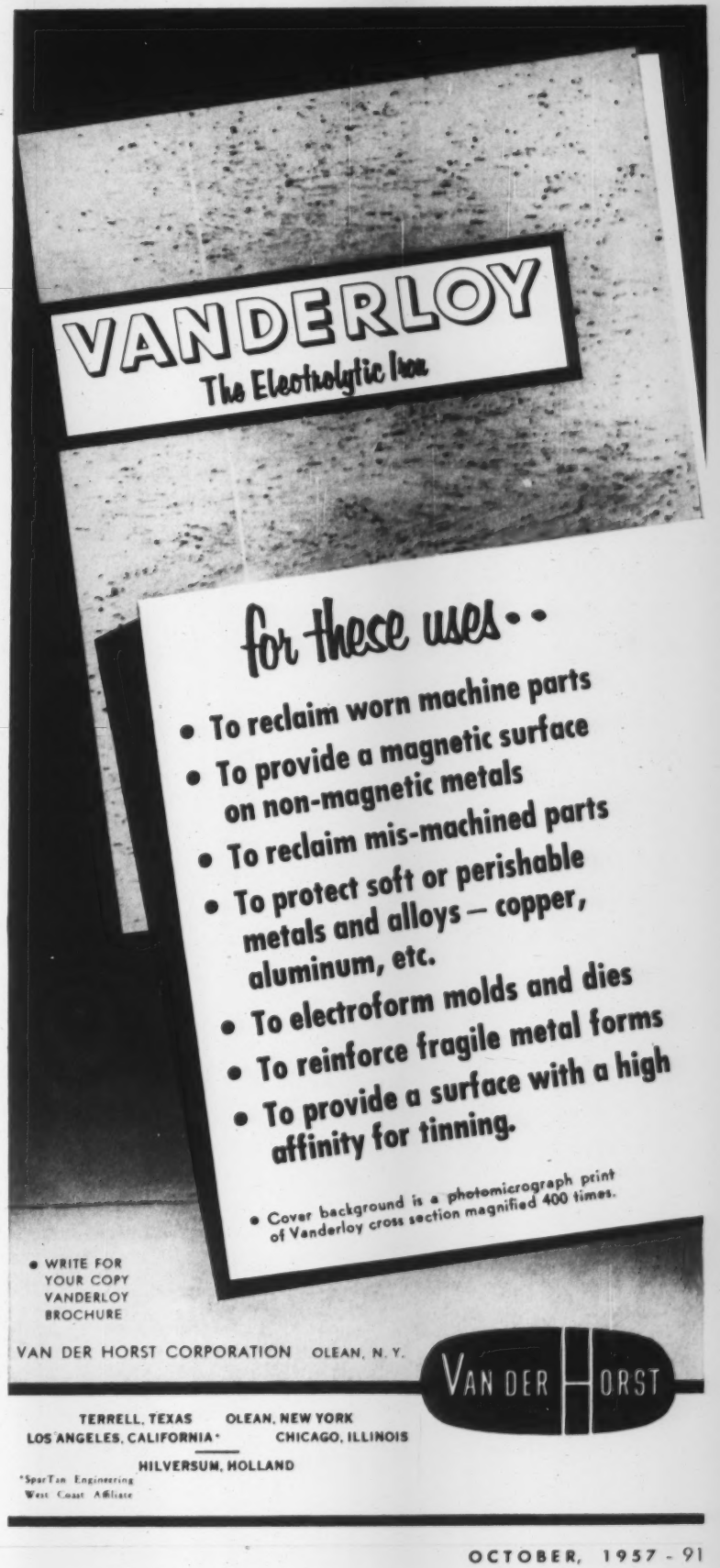
Rubber Sealing Ring

A new synthetic rubber sealing ring, named Wingseal is offered by Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio, for interchangeable use with AN6290 O-ring sizes on AND10056 fittings in the AND-10050 boss.

The new design has been evaluated in a two-part test, one using maximum seals in minimum bosses and the other minimum seals in maximum bosses, the company reports.

Hydraulic impulsing, using OS-45 fluid, was at the rate of 40 cycles per minute. Temperature was 400 F, with operating pressure 3000 psi, peak pressure 3600 psi, and rate of rise 175,000 psi per second. Wingseals in each of the maximum-minimum seal and boss configurations went through 50,000 cycles without any sign of leakage and were still pliable at the end of the test, the firm states.

Sizes, from 2 to 32 (used with fittings for tubing from 1/8 to 2 in. OD) are listed on page 11 of revised Catalog 5701, available from the company.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GOSHEN RUBBER CO., INC., 3010-7 S. TENTH ST., GOSHEN, IND.

Compact Indicators

A new line of compact indicators especially suitable for instrument control panel installations in central stations and power plants has been introduced by Hagan Chemicals & Controls, Inc., 323 Fourth Ave, Pittsburgh 22, Pa.

Identified as the SS series, these instruments can measure draft, pressure, differential gas pressure and temperature, or function as receivers with pneumatic transmitters for indicating flow, liquid level, density, high pressures and other process variables, the company reports.

As many as eight indicators can be grouped in a single mounting case, measuring less than 14 in. across. The illuminated 5-in. scales are made of white translucent plastic. All necessary adjustments can be made without removing the indicator element from the case, the firm says. Removal of the rear panel allows access to vernier adjustments of the pointer alignment, zero setting and calibration.

Three types of indicators—diaphragm, bellows or helix type—can be supplied. Each indicator is an integral unit assembled independently of the case. No matter whether the unit is a diaphragm, bellows, or helix type, it is interchangeable with all others. Even duplex units with two pointers on a single scale are interchangeable.

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Metal Finishing Regulator

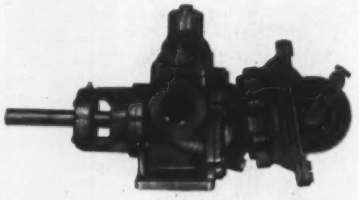
Development of a self-operated temperature regulator for use exclusively in metal finishing processes is announced by Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville, Tenn.

The manufacturer says the new control will provide accurate temperature regulation in plating, bonderizing, anodizing, cleaning, pickling and rinsing solutions. The use of special metals and plastics in the regulator, it is stated, insures long operating life and dependable performance.

A resistant plastic has been used to coat the temperature sensing bulb and connecting tube. Stainless steel is used for the frame. The body of the valve is made of a nonferrous metal.

The new temperature regulator, called No. PA-2, is available in seven valve sizes from $\frac{1}{4}$ to $1\frac{1}{2}$ in. Several bulb sizes are also available.

The regulator is equipped with a hand wheel to adjust temperatures within the limits of a selected range. A large thermometer is at the crown of the regulator.



Variable Pump

A new Vari-Cap pump has been announced by Granberg Corp. of Oakland 8, Calif. According to the company the name is derived from the fact that the pump's capacity can be changed to suit the product being pumped by a dial setting.

This new metering pump can be used for blending and processing operations, such as fuel oils, caustics, additives and various other chemical products, the firm reports. Speed of the pump can be adjusted to handle products of varying viscosities. The operation can be powered from standard capacity motors and the differential taken up in the pump's adjustment. The range of adjustment is from zero to 40 gpm at 500 rpm.

The pumps can also meet the special requirements of the liquid fertilizing field, it is reported. The pump is powered from the trailer wheel of the fertilizing rig. Once the volume is set, the output will remain constant with the rpm of the driver. When the rig speeds up, the output increases. When it slows down, it decreases. Thus liquid fertilizer is spread evenly, regardless of the varying speed of the vehicle, the company states.

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Integral HP Gear Motors

A new line of integral horsepower gear motors and related transmissions has been announced by the General Electric Company's Gear Motor and Transmission Components Dept., Paterson, N. J.

The new line will be offered in three basic components: an integral-type unit, functionally equivalent to previous designs where gear and drive motor are packaged into a single unit; an all-motor type which features the drive motor coupled to the gear reducer and mounted on a common carrier; and a separate helical speed reducer which may be used with a variety of prime movers.

Mounting dimensions on all three components are identical for similar rating and parts are interchangeable to give the user stock flexibility in back-up parts and units.

A new feature is a built-in provision for accomplishing ratio changes through a change of pinion and gear in the first stage only. Means for removing and replacing the pinion and gear are designed into each unit as captive assemblies.

The line will be offered in three basic types of speed reductions: single reduction offset shaft in speed ranges from 780 to 350 rpm; double reduction concentric shaft for speeds from 350 to 37 rpm; and triple reduction concentric shaft for output speeds from 30 to 13.5 rpm.

Integral-type gear-motors will be available in the new line from one to 30 hp. The first ratings, up to 10 hp, are being released now. The line will be completed through 30 hp by February 1, 1958.

Separate helical speed reducers and all-motor gear motors will be developed from one to 75 hp by July of 1958. The release of the initial sizes will coincide with the release of the corresponding gear motor ratings, the company advises.

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Flexible Couplings

A new line of flexible couplings taper-bored for use with QD taper bushings has been announced by Lovejoy Flexible Coupling Co., 4886 W. Lake St., Chicago 44, Ill.

Six different sizes range from 22 to 150 hp at 1750 rpm. Stock bushing bore sizes begin at $\frac{1}{2}$ in. and progress to $3\frac{1}{2}$ in. by $\frac{1}{16}$ in. The couplings will accommodate standard QD bushings, including types SD, SK, SFG and CE, the firm reports.

According to the company, the couplings have been adapted to taper bushings to provide reduction of normal stock requirements of coupling bodies; immediate availability of a wide range of shaft sizes from this reduced stock by means of a convenient complimentary stock of QD bushings; and a coupling-bushing combination that affords easy fastening to the shaft with the firmness of a shrunk-on fit.

Hydraulic Control Valve

Industrial Hydraulics Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio, announces a new line of hydraulic directional control valves for earth moving, material handling, agricultural and other mobile equipment.

First to be introduced is the VDP2 series nominally rated at 20 gpm capacity. The valves are engineered to provide excellent metering characteristics in raising, positioning, rotating, holding or lowering operations and feature exceptionally low pressure drop, the company states. They are available in 1-, 2-, 3-, 4- and 6- spool models.

Recommended operating pressure is up to 2000 psi. Open center parallel circuit design is said to permit independent or simultaneous operation of two or more cylinders or hydraulic motors at one time. Spool types, available in any sequence, include single-acting, double-acting and float.

Spools, which are fully balanced radially and axially, have spring return to neutral from operating position, or can be furnished with various detent arrangements. Each spool has its individual check valve to prevent load drop when changing spool operating positions. The integral differential type relief valve is quiet operating, has low pressure rise from crack to full flow, and is externally adjustable, the firm says.

CRUSHING FUSED WELDING FLUX saves $10,000.00 per year

A large manufacturing plant formerly discarded approximately 100,000 lbs. of fused welding flux a year from their submerged arc welding process. Now, an American Welding Flux Crusher regranulates the fused welding flux, the fines are separated, and the flux is reused. With new welding flux costing approximately 10¢ per pound, this company makes a saving of $10,000.00 per year.

The low cost of an American Welding Flux Crusher is quickly paid for and you make a substantial saving even if your submerged arc welding operation is much smaller than the case cited above.

We suggest you write us now. We'll be pleased to quote on the correct size crusher for your operation and assist you with engineering advice to salvage fused welding flux.

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ASH HANDLING

Few materials are as abrasive as ashes. The design of Nagle Pumps plus the abrasion-resistant materials of construction used, combine to assure a maximum service life with minimum maintenance, in ash handling service. For many years, in many power plants, Nagles have served unstintingly. Two Nagle, vertical shaft, centrifugal pumps, 6", type "CWS-R," are incorporated in the ash disposal system of the Gallatin Steam Plant of the TVA, Gallatin, Tenn. Send for data on Nagle Ash Handling Pumps. Nagle Pumps, Inc., 1299 Center Ave., Chicago Heights, Illinois.

NAGLE PUMPS

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Missile Adhesive

A new, high performance adhesive, designed specifically to eliminate the need for core priming in aircraft and missile sandwich component fabrication and to provide materially improved peel strength, has been developed by Narmco Resins & Coatings Co., 600 Victoria St., Costa Mesa, Calif.

Tradenamed Narmtape XP-108, the new adhesive is claimed to be the first "asymmetric" structural adhesive to be made available to the aircraft industry. It consists of a nylon carrier impregnated with a modified phenolic resin and overcoated on one surface with a highly mobile filleting resin.

The addition of the filleting resin, according to the manufacturer, will eliminate one of the most time-consuming steps in the fabrication of a wide variety of aircraft and missile structures of bonded sandwich design. The priming step in the fabrication of bonded sandwich structures is completely eliminated because the filleting resin has, in effect, been built into the new, multiple-coated adhesive.

Good filleting action on the part of a sandwich adhesive, the firm points out, enables the adhesive to provide added contact area to the columns of a sandwich core. This is said to materially improve the peel strength and other mechanical properties of the completed face-to-core bond in a sandwich-type structure.

Lapping Technique

Lapmaster Div., Crane Packing Co., Dept. MKN, 6400 Oakton St., Morton Grove, Ill., has introduced a new technique for obtaining critical flatness and parallelism in the production of germanium, silicon, quartz, barium titanate and lead zirconate crystals and wafers.

A lapping operation of a Lapmaster, in combination with the new patented diamond fixture, can produce a flatness under 3 light bands, a parallelism of 50 μ in. and a thinness of .001 in. on these crystals or wafers, the company reports.

In the first side operation, the crystals or wafers are lapped with little or no fixturing on a standard machine. In this operation, they are lapped to approximately 2 light bands (23.2 millionths of an inch).

In the second side operation, the blanks are affixed to the specially designed diamond fixture for finish lapping. This triangular steel plate, lapped to a flatness of two light bands, has adjustable diamond stop points at each leg to limit the travel of the fixture in the lapping cycle. The diamond stops can be set to microinch accuracy to provide the desired crystal blank finish thickness. The diamond points, being extremely resistant to aluminum oxide abrasive, act as positive stops thus predetermining the lapping operation to the limit set within the range of the abrasives' particle size, the firm explains.

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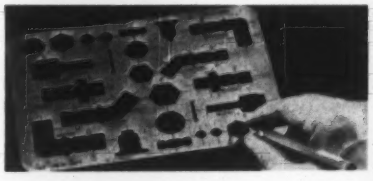


Flareless Fitting Templates

A series of five drafting templates for layout of MS type flareless fluid fittings has been announced by E. F. Twomey Co., Inc., Box 15913, Los Angeles 15, Calif.

Originally designed by Douglas Aircraft Co., Inc., the templates are made of .025 in. vinyl plastic, amber-coated.

The five new templates contain cutouts for $^3/_{16}$ and $^5/_{16}$ in. tube sizes, $^1/_4$ and $^3/_8$, $^1/_2$, $^5/_8$, and $^3/_4$ in. The corresponding MS part number is shown opposite each cutout. Parts reproduced in each size are: MS21902 and MS21924 unions; MS21904, MS21907 and MS21908 elbows; MS21909 and MS21912 tees; MS21913 plug; MS21916 reducer; MS21921 and AN6289 nuts; MS21922 sleeve; and AND10050 boss.

Elevating Bulk Loader

An automatic bulk loader with a 4 cu ft hopper has been announced by Feedall, Inc., 38399 Pelton Rd., Willoughby, Ohio. Cycled for automatic loading of a vibratory feeder, the Model 2400 loader is self-contained and is powered by a $^1/_2$ hp motor and variable speed drive with electrical controls. Parts are picked up from the hopper by metal cleats on the moving conveyor and elevated to deliver into the vibrator feeder.

The unit can be modified to feed rolling or sliding parts in a wide range of sizes, the company states. Other advantages are low loading height, variable angle of conveyor elevation, the power take-off from the conveyor cam at left, right, or both sides.

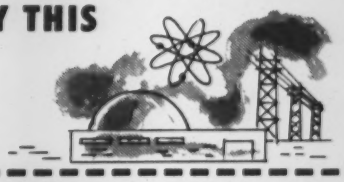
Iron Safety Valves

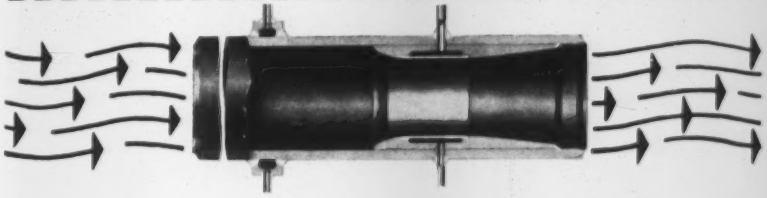
A new series of low-cost top guided, semi-nozzle, cast iron safety valves for steam generator service said to offer exceptional capacity in the smallest possible valve size has been announced by Farris Engineering Corp., 612 Commercial Ave., Palisades Park, N. J.

The new 1900 and 2900 series valves offer a maximum pressure of 250 psig at 450 F, and are ASME approved for Power Boiler and Unfired P V codes. A choice of 21 nozzle sizes and seven body sizes from $1^1/_2$F2 to 6S8 is offered.

The 1900 series has hardened stainless disks and two-point extra-long guiding. Trim is of bronze or stainless steel. The 2900 series is the same construction with the exception of variations in caps and trim materials.

PRODUCTIVE ATOMS POSED A "HOT" METERING PROBLEM... SOLVED BY THIS BUILDERS FLOW NOZZLE!!





This Flow Meter is in the primary loop of every major atomic reactor in America — from the Nautilus to the Shippingsport Power Plant.

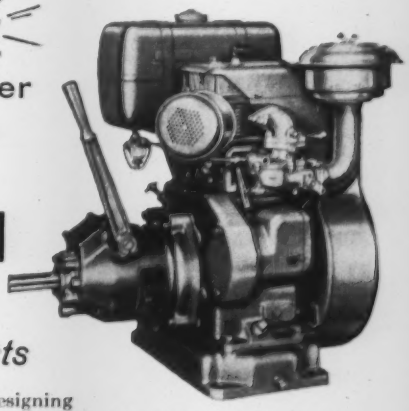
- Only flow nozzle offering the accuracy, range, low head loss, freedom from upstream disturbances, and other desirable characteristics of the Venturi Tube.
- Built to ASME pressure vessel code.
- Designed for high temperature — high pressure applications (power plants, high pressure lines, atomic reactors, etc.).
- Nozzle can be factory inserted in any customer-supplied high cost, special pipe at considerable savings.
- Completely drainable on modified designs; modified versions excellent for slurries.
- Design based on the most comprehensive compilation of primary element/fluid flow data available anywhere.

Let Builders application engineers solve your flow metering problems.

BUILDERS-PROVIDENCE
A DIVISION OF
B-I-F INDUSTRIES

Write Builders-Providence, Inc., 382 Harris Avenue, Providence 1, Rhode Island.

a BIG NEW
4-cycle, single cylinder
air-cooled engine
the
WISCONSIN
12½ hp Model AGN
... by Engine Specialists



Model AGN Engine with Clutch Assembly. Also available with stub shaft or with Reduction, Clutch Reduction and/or Electric Starting.

Backed by an exclusive engine designing and production background dating from 1909, plus today's most advanced engineering knowledge and technique, this new engine is destined to become another BIG winner!

Putting 12½ hp. into a single cylinder air-cooled engine calls for basic *High Torque* . . . the *load-holding Lugging Power* that keeps the equipment *working* through sudden shock loads. It also calls for heavy-duty construction in all details . . . plus dependable cooling under all weather conditions from sub-zero to 140° F.

Bulletin S-216, just off the press, will give you details about the Model AGN. Write for it.

WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN

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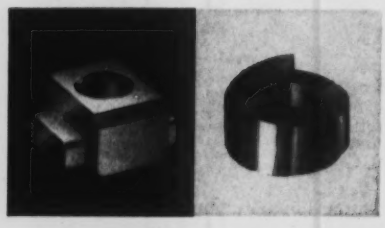

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Heat Exchanger

Lear, Inc., Elyria, Ohio, announces Model RR20090 airborne electronic heat exchanger with a nominal heat dissipation rate of 6000 w total for both fluid circuits while maintaining a maximum liquid outlet temperature of 180 F from sea level to 20,000 ft.

The maximum cooling air temperatures at this performance rating are 131 F at sea level and 118 F at 20,000 ft, the company reports.

The dual pump is designed to circulate coolant through separate circuits. One element of the pump has a minimum rated capacity of 1 gpm with a 65 psi gage discharge pressure and the other pumping 10 Centistoke 200 silicone fluid.

The basic components that make up the unit are a liquid-to-air heat exchanger, an electric motor driven axivane fan and an electric motor driven liquid pump. Both motors are continuous duty and operate on 208 v, 3 phase, 400 cycle. The pump motor is rated at 0.25 hp at 2500 rpm and the fan motor is rated at 1.25 hp at 11300 rpm.

Incorporated in the unit for warning purposes is a flow switch in each fluid circuit and a liquid hi-temperature cutout switch for electrical interlock in the external electronic circuit. Also included is a fluid pressure reservoir, a power time delay relay to eliminate starting current surge through the interlock circuits, and panel warning lights to indicate low liquid flow and high liquid temperatures.

Pitch Gear Charter

What is described as an accurate, automatic method for checking fine pitch gears on a production basis has been developed by Machine and Instrument Div., Illinois Tool Wks., 2501 N. Keeler Ave., Chicago 39.

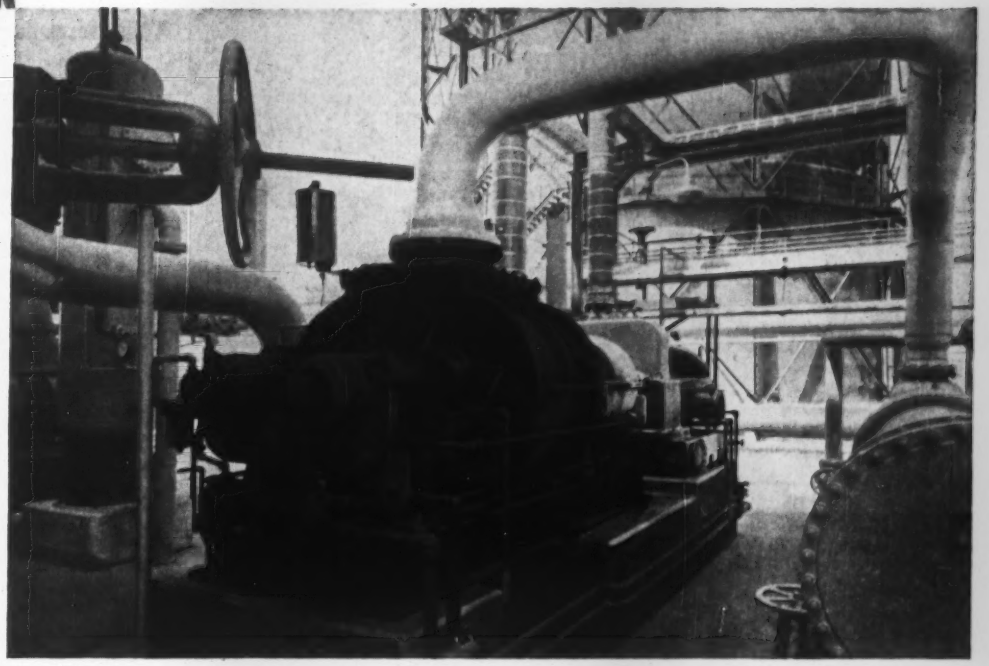
The instrument, called Micrac, delivers a permanent, visual record of gear quality on straight line graph paper. Both spur and helical gears can be inspected, the firm reports.

The company says the new principle introduces a master worm of extreme accuracy that rotates in intimate contact with the work gear. Worms are manufactured integral with a rigid shaft and are hardened and ground to controlled limits. The single thread worm makes one complete convolution for each tooth in the production gear. Any error in the master worm, then, repeats in the chart for each tooth and can be easily subtracted. Adequate worm face is provided so that the worm can be re-positioned.

The recording mechanism consists of an electronic pick-up and amplifier. Capacities are $\frac{3}{8}$ to 3 in. center distance; 0 to 9 in. distance between head and tailstock centers; amplification range from 200:1 to 800:1; master worms to 180 DP.

MATHIESON

For Olin Mathieson



R-C pumps and blowers control air and gas mixing

In the manufacture of ammonia at this large Olin Mathieson chemical plant at Lake Charles, Louisiana, large volumes of hydrogen, nitrogen and air are positively proportioned and compressed by Roots-Connersville equipment.

R-C Gas Pumps are teamed with Rotary Positive Blowers to handle pure hydrogen gas and air for processing into a 3:1 hydrogen-nitrogen synthesis. Another R-C Gas Pump compresses this mixture to supercharge other equipment.

Inherently high efficiency of the famous R-C rotary positive design, extremely low friction loss and extra deep stuffing boxes are a few of the reasons why this equipment delivers maximum performance within rated capacities.

Here is another example of the widespread application of R-C equipment in the process industries. If you have a product or a process requiring handling and accurate control of air or gas, Roots-Connersville engineers will welcome the opportunity to give you the benefit of their long experience. Address your inquiry to Product Development Manager.

R-C Rotary Positive Equipment purchased for this installation

22 x 29 Gas Pump rated 4975 cfm, 514 rpm, 425 Hp

14 x 28 Gas Pump rated 4250 cfm, 830 rpm, 112 Hp

10 x 18½ Blower rated 1770 cfm, 830 rpm, 37.6 Hp

The 14 x 28 Gas Pump and 10 x 18½ Blower are direct-driven in a single assembly.

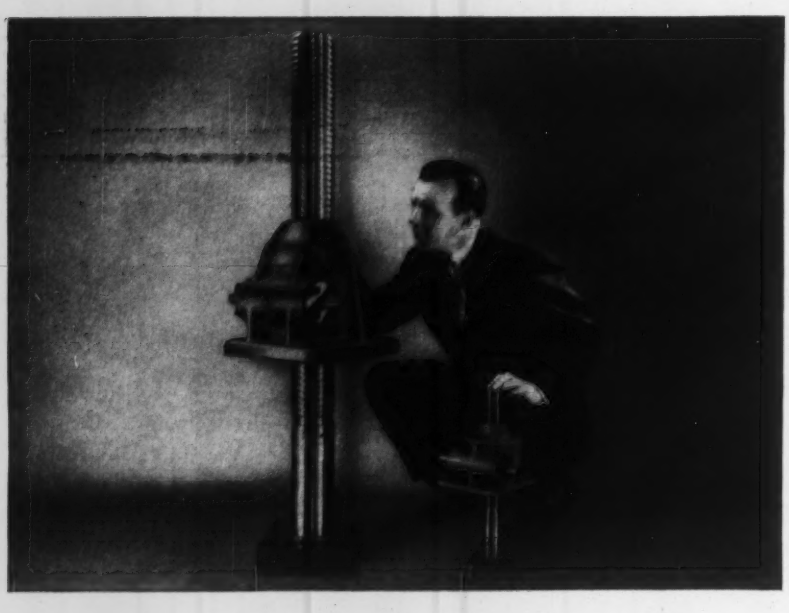
The 22 x 29 Gas Pump functions as a supercharger for the 3:1 hydrogen in nitrogen gas mixture.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

1057 Michigan Avenue, Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

Engineers – unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.



Here's A Device Every Machinery Designer Should Know About . . .

It's the Duff-Norton Worm Gear Jack, successfully used by many machine builders as a component of equipment for precise, positive control of linear motion, applying pressure, resisting impact. Two or more of these jacks can be connected by means of shafting and mitre gear boxes to give a positive drive, so that jacks always raise or lower under equal or unequal loads in perfect unison. Capacities range from 5 to 50 tons with any raise up to 25 inches; worm gear ratios, 6¾:1 to 32:1; turn of worm for each 1-inch raise, 10 to 48; available in either Acme or square threads. For protection against foreign matter certain models can be furnished with bellows boots.

Thousands of these jacks are in use today for table adjusting—machine adjusting—rolling mill adjusting—raising and lowering conveyors, machine beds, molds and dies, furnace lids, loading platforms, loading racks, gates, hinged mechanisms, arbor presses—adjusting electrodes—adjusting welding positioners.

Duff-Norton Worm Gear Jacks are available in 6 standard sizes. For complete specifications and detailed drawings, send for your free copy of a special brochure.

DUFF-NORTON Company

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Department ME
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Please send immediately a free copy of your new Worm Gear Jack Brochure.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Teflon Insulating Material

A new Teflon film said to have exceptional thermal stability and the lowest coefficient of friction of any known material has been added to the standard line of insulating materials of the Permacel Tape Corp., New Brunswick, N. J.

The new material, called Permacel 415 extruded sintered Teflon film, is claimed to have electrical and physical properties generally higher than any other form of Teflon film. The material functions effectively in temperatures ranging from −200 to 500 F, making it suitable for Class H electrical applications and aircraft, missile and industrial jobs requiring resistance to high heat.

According to the company, the material is resistant to practically all chemicals and solvents. Basic average properties of the new product are tensile strength, 110 oz-in-mil; elongation, 300 per cent; dielectric strength, 2500 volts/mil; moisture absorption, zero; non-flammable.

Permacel 415 comes in thicknesses of from .002 to .040 in. The standard color is clear; other colors are available.

Mechanical Separator

Metal Finish, Inc., 412 Frelinghuysen Ave., Newark 12, N. J. has introduced a new industrial mechanical separator.

It is fabricated of heavy steel construction and measures 96 in. long by 80 in. high by 37 in. wide. Light or heavy parts can be handled with the same ease of operation, the firm states. The unit has an adjustable stroke ranging from ¼ to 1¼ in. which operates through an eccentric gear to achieve high speed production, in addition to small changes, with a varidrive expansion pulley.

Synchronous Motor

A new reduced size heavy duty synchronous motor with a torque rating of 40 in-oz at 1 rpm has been introduced by Hurst Tool and Mfg. Co., Princeton, Ind.

Standard models of the motor are available with speeds of ½ to 360 rpm through gearing, and 1800 rpm direct drive.

The motor starts instantly with full load at rated torque and will operate continuously with a maximum temperature rise of only 45°C above ambient, the firm states. Housed in a stamped steel case, it measures 2½ in. in diam and 1¾ in. in depth. Three No. 8 mounting holes are spaced 120 deg.

Operative in any position, the motor can be stalled indefinitely without damage to the coil. A ¼ in. drive shaft is standard, and shafts of any length are available.

The motor operates on 115 v, 60 cycles and draws 7 w. Its timing accuracy is maintained through a temperature range from −40 to +250 F.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Opposed-Spindle Drilling

A new opposed-spindle drilling machine featuring a low-cost, flexible automatic system for positioning heads and table for producing hole patterns has been developed and built by Walter P. Hill, Inc., 22183 Telegraph Rd., Detroit 19, Mich.

The firm states that the fully automatic, hydraulic-powered, electrically-controlled machine has been especially developed for drilling holes in tube sheets and baffles in condensers, heat exchangers, evaporators, heaters and all types of heat transfer equipment, including equipment for atomic energy power plants. The machine, which will handle sheets and baffles up to 6 ft diam and 10 in. thick, will produce holes at feed rates up to 18 in. per min with conventional oil-flute drills.

Uniform, straight, round holes are produced in a single drilling operation without reaming, the company says. Tube sheets and baffles can be drilled separately or stacked with assurance of accurate alignment at assembly for easy tube insertion.

The new system which replaces a former index bar design, is applied to control both head and table index functions. Vertical and horizontal indexes are controlled by individual escapement wheels that are moved by shaved gears driven by racks and pinions on the table and heads through shafts. New hole spacings for different parts are obtained by inserting suitable change gears between the shaft and the escapement wheel.

The machine has two hydraulic power heads mounted opposite each other. The heads each travel vertically on a pair of 6 in. diam solid steel columns. The work fixture is mounted on a table having positively lubricated Amco bronze steel backed ways that travel on ground ways hardened to 67 Rockwell C scale. According to the company, an operator can walk on these exposed ways with chips under foot and not damage them. Hardened, self-contained roller followers guide the fixture at the top during indexing and maintain fixture alignment with the drill heads to prevent the production of oval or barrel-shaped holes.

PAST EXAMINATIONS
for Professional Engineers given by New York State

This pamphlet contains the questions given in 1952–1956 examinations. They cover problems in structural planning and design, in practical applications of basic engineering sciences, and the more advanced and specialized problems in practical applications of engineering principles and methods.

$2.00 (20% Discount to ASME members)
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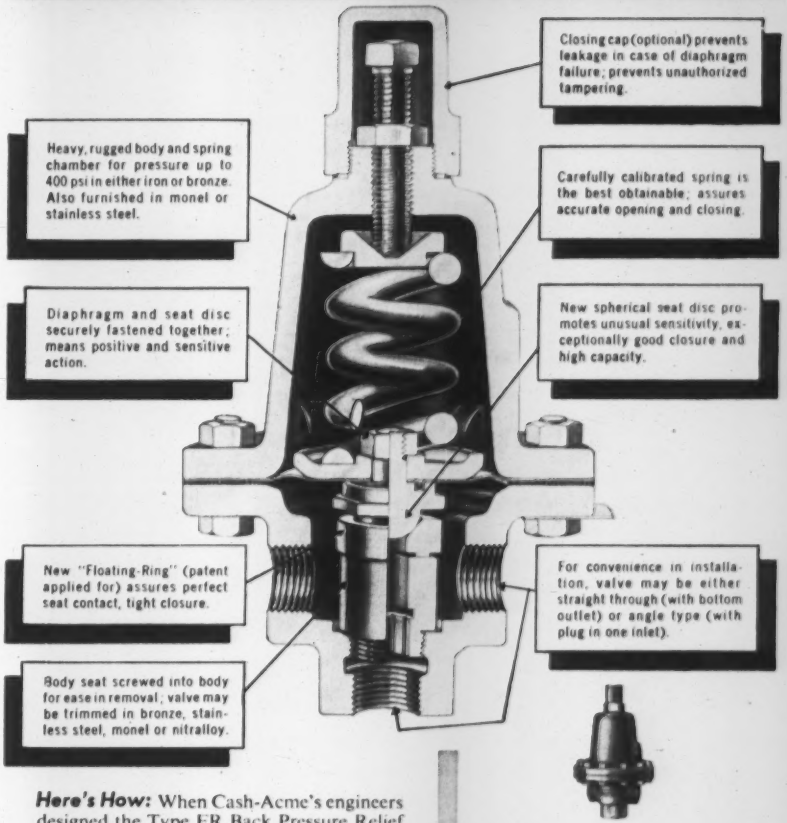
29 W. 39th St., New York 18, N. Y.

how Cash-Acme provides the Correct Answer to high back pressure valve maintenance costs


Closing cap (optional) prevents leakage in case of diaphragm failure; prevents unauthorized tampering.
Heavy, rugged body and spring chamber for pressure up to 400 psi in either iron or bronze. Also furnished in monel or stainless steel.
Carefully calibrated spring is the best obtainable; assures accurate opening and closing.
Diaphragm and seat disc securely fastened together; means positive and sensitive action.
New spherical seat disc promotes unusual sensitivity, exceptionally good closure and high capacity.
New "Floating-Ring" (patent applied for) assures perfect seat contact, tight closure.
For convenience in installation, valve may be either straight through (with bottom outlet) or angle type (with plug in one inlet).
Body seat screwed into body for ease in removal; valve may be trimmed in bronze, stainless steel, monel or nitralloy.

Here's How: When Cash-Acme's engineers designed the Type FR Back Pressure Relief Valves, they put *your* rising maintenance costs foremost in mind . . knowing that "down time" is extremely important. This superior valve series, therefore, is built to *exacting* specifications, featuring the nearest thing to *friction-free* operation as is possible to attain, which means less wearing of parts, longer life.

Do as other cost-conscious engineers and purchasing men are doing and switch to CASH-ACME.

A fact-jammed bulletin, with honest and accurate capacity charts, is available free of charge. Write today.

TYPE "FR"—Rugged Industrial Type Back Pressure Relief Valve, automatically maintains correct pressure on inlet, relieving to a lower pressure or to atmosphere. For 0 to 400 psi; ½" to 2" pipe sizes. Suitable for:

- AIR • WATER (Hot or Cold)
- GASOLINE
- OIL (Light or Heavy)
- FUEL TAR • AMMONIA
- FREON • BRINE • CO_2
- FISH OIL • NITROGEN
- HYDROGEN • ALCOHOL

Modified for:

- VACUUM RELIEF
- CONSTANT DIFFERENTIAL REGULATOR

FOR THE *Correct Answer*
CASH AUTOMATIC VALVES ACME

A. W. CASH VALVE MANUFACTURING CORP.
6627 East Wabash Avenue
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it's easier to open or close
a GOLDEN-ANDERSON
valve
than to drive a car with
POWER STEERING
Bulletin G-4 tells why G-A valves operate so easily — it's a part of our complete catalog!

Because Golden-Anderson valves use the liquid in the line to operate the valve. Quick positive action is assured regardless of pressure or size of the line. A simple turn of a lever or push of a button is all that's needed.

Get the complete facts on Golden-Anderson valves today!

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AURORA®
General Purpose
CLOSE-COUPLED
CENTRIFUGAL PUMPS

IDEAL for
AIR CONDITIONING
REFRIGERATION
COOLANT
HOT WATER
CHEMICAL*
GENERAL PURPOSE
*In special alloys to meet specific conditions

These are compact, simple, lasting pumps with low NPSH characteristics to meet critical suction conditions — for wide range of duties including hot water and chemicals handling.

TYPE BJF FLANGE MOUNTED

MANY VALUE FEATURES

CONSULT WITH US

SEALS or GLANDS — Available in either as desired.

SPEEDS — 3,500, 1750 (60 cycle) and 2,880, 1,440 (50 cycle) speeds.

CURRENT — AC or DC — All voltages and phases.

MOTORS — 1/6 to 7-1/2 H.P. drip-proof, splash-proof, totally enclosed, explosion-proof and chemical. Quiet, efficient NEMA standard.

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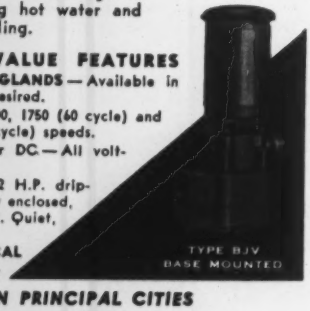

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Platform Attachment

Yale Materials Handling Div., Yale & Towne Mfg. Co., 11,000 Roosevelt Blvd., Philadelphia 15, has developed a workman's platform and boom attachment for industrial lift trucks for the accomplishment of overhead maintenance tasks involving bulky or heavy pieces of plant equipment.

The platform comprises 24 sq ft of working area and can be fitted with a removable guard rail for safety. The attachment's removable boom, fitted with a hook which accommodates a hand hoist or ratchet hoist, has a capacity of 300 lb and slews through 180 deg. The boom outreach is 48 in.

This attachment is designed to fit directly onto a standard fork carriage. It can be modified to be picked up on a pair of 48 or 60 in. long forks so that the truck can serve double duty as a production tool and piece of maintenance equipment, the firm reports.

Gear Hobber

A new high-speed gear hobber, Model 1458-B, has been developed by Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich.

The unit is a horizontal single-spindle machine said to be versatile enough for small shops, yet easily installed in automated gear lines of big plants. The new hobber has an 8-in. center distance between hob arbor and work spindle.

The entire hobbing cycle is fully automatic with the machine returning to the loading position upon completion of the part. Loading and cutting time for most gears is measured in seconds, the firm says. Either conventional or climb hobbing may be used with single or multiple thread hobs. Gear washers and gear classifiers can be integrated with the machine. Automatic size control can also be provided.

Digital Weighing

Digital, electronic weighing is said to be possible with a new system available from Performance Measurements Co., 15301 W. McNichols Rd., Detroit 35, Mich. It is applicable to laboratory and production batch-weighing uses, the firm states.

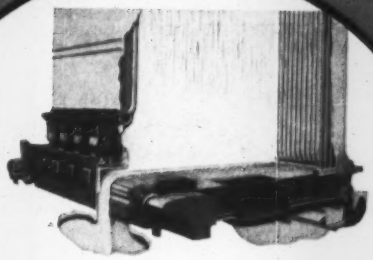
The system combines a load cell, containing strain gage pickup, with a digital indicator. The indicator features a continuous balance electronic potentiometer and a servo motor driving precision number wheels.

Accuracy of the system is 0.1 per cent, and readability is one part in ten thousand using four number wheels, the company reports. Output readings may be calibrated in quantities such as pounds or ounces. It may also be calibrated in pieces so that the system can be used for weigh-counting. The system is also available with coded digital output for connection to computers or central recording stations.

USE DETROIT SPREADER STOKERS TO BURN SOLID FUELS WITHOUT EXPENSIVE PREPARATION

DETROIT ROTOGRATE • ROTOSTOKER • ROTOSTOKER (TYPE C-C)
HIGH ECONOMY AND AVAILABILITY • LOW MAINTENANCE

1



DETROIT ROTOGRATE

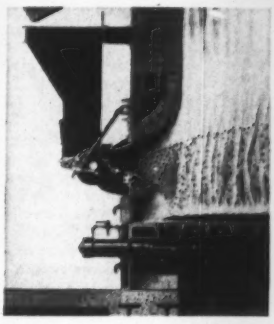
Original spreader stoker with forward moving grates that discharge the ash at the front. Our long experience has contributed to many exclusive refinements and features of design. Proven superiority with hundreds installed here and abroad. For capacities up to approximately 400,000 pounds of steam per hour.

Detroit Stokers burn any Bituminous Coal or Lignite without special preparation. Commercial sizes ranging from ⅜" x 0" to 1¼" x 0" are ordinarily used. High burning rates without clinkering difficulties. Also many refuse fuels including wet bark, hogged wood, bagasse, etc. are burned separately or in combination with coal; efficiently and without smoke.

Widely fluctuating loads are easily handled. Parasite power is negligible. High overall efficiencies at all capacities are assured. Maximum availability and very low maintenance.

Buy "Detroit"—They are "the most".

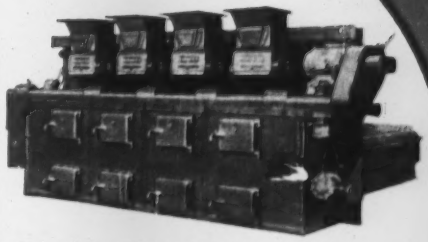
2



DETROIT ROTOSTOKER

For small and medium size units. Power Dumping, Hand Dumping or Stationary grates to fit the furnace provide desired capacity under full automatic control.

3



DETROIT ROTOSTOKER (TYPE C-C)

Continuous cleaning type particularly suited to highly fluctuating loads. Many sizes for capacities of 5,000 to 75,000 pounds of steam per hour. Reciprocating grates discharge ash at front. No basement is required.

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POWER TRANSMISSION EQUIPMENT EASILY INSTALLED, MAINTENANCE-FREE

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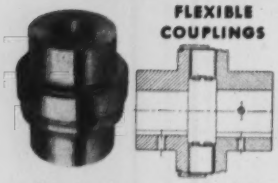
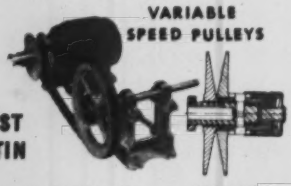


REQUEST BULLETIN C-56

Bores (max.).....⅛" to 9½"
O.D. .....⅝" to 21½"
Wt. .....½ oz. to 1500 lb.
H.P. .....1/20 to 3000
Torque (static).1½ to 5100 ft.-lbs.

VARIABLE SPEED PULLEYS



REQUEST BULLETIN 118

Bores (max.).....½" to 1⅝"
O.D. .....3" to 13⅝"
Belt Sizes.....A to 2⅝ TW
Speed Ratios.....1-1 to 8-1
H.P. (1750 rpm.).....¼ to 15

SELECT-O-SPEED TRANSMISSIONS

REQUEST BULLETIN 118

Controls.....Lever or Hand Wheel
Belt Sizes.....A to C
Speed Ratios.....1-1 to 10-1
H.P. (1750 rpm.).....½ to 7½

UNIVERSAL JOINTS

REQUEST BULLETIN 820

Bores.....¼" to 2"
Hub Dia. .....½" to 4"
Static Torque
340 to 130700 in.-lbs.
H.P. (100 rpm.).....½ to 207

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KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Pneumatic Actuator

Redesigned diaphragm control valve pneumatic actuators are announced to be in full production by Hammel-Dahl Co., Warwick Industrial Park, Providence 5, R. I.

According to the company, an outstanding feature of the design is a new split-coupling which joins the actuator spring stem to the valve plug stem. The stems do not engage or do not meet, the firm says.

By loosening three nuts, the actuator may be lifted over the plug stem. Slotted holding clips and the coupling arrangement allow the actuator to be completely removed without disturbing the packing box bolting.

No valve disassembly is required when positioner is mounted in the field. Every valve is equipped with a universal bracket for the mounting of any positioner.

The new actuators are available in three standard sizes, with each size covering twelve different constructions. Three spring ranges —3–15, 5–25, and 6–30 psi—are interchangeable in each size and type of actuator.

BUSINESS NOTES

Opens Seattle Office

Foster Wheeler Corp., designer and constructor of petroleum, chemical and nuclear plants, and manufacturer of equipment for public utility, industrial and marine power plants, has opened an office in the Vance Building, 3rd and Union, Seattle, Wash.

Consolidates Pump Sales

Manufacturing and sales for all Byron Jackson Standard Line pumps are now headquartered in Lawrenceburg, Ind., according to an announcement by the company. Previously, executive management for these pumps was centered in Los Angeles with Lawrenceburg operating as one of several manufacturing plants.

New Gasket Plant

General Gasket Inc., maker of gaskets, shims and sheet stock, has announced removal of its manufacturing operations to a larger and more efficient plant located at 306 Stack St., Middletown, Conn.

Distributor Named

Allied Supply Co., 4240 Santa Ana St., South Gate, Calif., has been named the distributor of Sola-Flex industrial expansion joints for the 10 southernmost California counties and Clark country, Ariz., the Solar Aircraft Co., announces.

INTERESTED

in keeping your copy of the 1956 ASME Boiler and Pressure Vessel Code up-to-date?

Then send for the following

1957 ADDENDA

To Section I, POWER BOILERS

For new requirements covering materials not fully identified, and amplification of the special rules applying to vapor generators .....25¢*

To Section II, MATERIALS SPECIFICATIONS

For methods and definitions for mechanical testing of steel products, specifications for cast nodular iron for pressure containing parts for use at elevated temperature, and a list of specifications revised by the ASTM, and adopted by the Boiler and Pressure Vessel Committee.....50¢*

To Section IV, LOW-PRESSURE HEATING BOILERS

For new rules governing the wall thickness of plain cylindrical furnaces or flues and chart for determining the wall thickness; provisions for inspection and stamping of a boiler unit furnished by one manufacturer, not assembled and subjected to hydrostatic test prior to shipment; and alterations to other paragraphs of the Code.....25¢*

To Section VIII, UNFIRED PRESSURE VESSELS

For a new section containing rules for unfired pressure vessels constructed of cast nodular iron; changes in the requirements for thickness of cylindrical shells; revisions to allowable stress values in table UNF-23, additional provisions effecting cylindrical shells under external pressure with supplementary loading, and charts for determining shell thickness of cylindrical and spherical vessels under external pressures when constructed of aluminium alloy 996A-0, GR20A-0 or GR20A-H112; and cast nodular iron.....50¢*

To Section IX, WELDING QUALIFICATIONS

For additions to tables Q-11.1, QN-11.1, and QN-11.2 as well as revisions to other tables and paragraphs.....25¢*

*Prices to members and nonmembers.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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New York 18, N. Y.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Appoints Canada Agent

Formsprag Co., Van Dyke, Mich., manufacturer of over-running clutches, has appointed Renold Chains Canada Ltd. as its exclusive sales representative for Canada. Renold has headquarters in Montreal and branch offices and warehouse stocks in Vancouver, B. C., Winnipeg, Man., London, Ont., Hamilton, Ont., Toronto, Ont., Montreal, Que., Three Rivers, Que., and Quebec, Que.

Opens Dallas Office

Opening of a Southwestern regional sales office has been announced by Commercial Shearing and Stamping Co., Youngstown, Ohio. Located in the Exchange Bank Bldg., Dallas, the office will serve Mississippi, Louisiana, Oklahoma, and Western Tennessee in addition to Texas.

Opens Stamping Plant

Federal Tool and Mfg. Co., 7347 Atoll Ave., Minneapolis, Minn., has opened a new short-run stamping plant in North Hollywood, Calif. This new West Coast division operates under the name Federal Stamping Co. and offers facilities for producing "controlled tolerance" short-run stampings.

LATEST CATALOGS

Gear Cutting, Grinding

Norden-Ketay Corp., Commerce Rd., Stamford, Conn., announces an illustrated four-page bulletin No. 431 describing its Florida Gear Division's capabilities and facilities for gear cutting, gear tooth grinding, thread and worm grinding, heat treating, grinding (cylindrical, internal, surface and centerless), deep hole drilling, precision reduction units for servo motors, and contract gear and gear train assembly manufacturing.

Bending Machines

Pines Engineering Co., 601 Walnut St., Aurora, Ill., has announced a new catalog on bending machines with illustrations of many previously unpublished applications.

The catalog, designated No. 356, has more than 90 photographs of bending machines showing 65 different applications in bending tubing, pipe, extrusions and rolled sections. A brief discussion of bending practices precedes the catalog information. Photographs show more than 50 different tooling set-ups in closeup.

A TALENT FOR INVENTION: Leroy® Lettering Equipment—a K & E development—insures perfect neatness and uniformity, yet it is simple to operate and requires no special skill or training. One man can start a job and another finish it without any variation in lettering.

This K & E equipment comprises three basic, precision engineered parts: Leroy template, Leroy pen and Leroy scriber. Capitals, lower case, numerals, vertical or forward slanting letters can be drawn from a *single* template—an *exclusive* K & E feature. You can buy templates, pens, and scribers separately or in convenient sets.

Leroy templates offer a variety of alphabets, sizes and graphic symbols. Electrical, mathematical, mapping, geological and other symbol templates are available. Templates, with words or phrases that are frequently repeated, as well as templates with your own symbols, trade marks or designs, can be made to your order.

To save time and money in your drafting room specify K & E Leroy® Lettering Equipment. For other drafting or engineering equipment and materials also look to Keuffel & Esser Co.—your "Partners in Creating"—who have served engineering for 90 years.

K+E **KEUFFEL & ESSER CO.** New York, Hoboken, N. J., Detroit, Chicago, St. Louis, Dallas, San Francisco, Los Angeles, Seattle, Montreal.

YODER SLITTERS Supply Varied Strip Widths for Tinnerman *Speed Nuts*

Tinnerman Products, Inc., Cleveland, Ohio, produces more than 10,000 different shapes and sizes of "SPEED NUT" brand fasteners for industry . . . many of them to special specifications.

To do this, Tinnerman uses slit steel strands ranging in width from ⅛" to 7½". To carry an inventory of the many strip widths required to meet normal and unusual demands would be almost impossible.

Tinnerman overcomes these inventory and supply problems by doing their own slitting on two Yoder slitters. This enables them to supply the plant with any strip size required from a relatively small inventory of 6" and 9" width purchased coils. In slitting narrow strands, such as these from small coils, a Yoder slitter may be profitable on a production as low as 25 tons per month.

Here is a fine example of how a small investment in Yoder slitting equipment greatly simplifies and speeds production while effecting important operating economies.

The saving made in time alone, reflects in better customer service through faster completion and delivery of finished products.

If your steel strip or sheet slitting requirements are as low as 100 tons per month or even less, a medium size Yoder slitter can be a very profitable investment for you. The Yoder line includes units of every size and capacity . . . of the most advanced engineering design. Send for the Yoder Slitter Book —a comprehensive text on the mechanics and economics of slitters and slitting line operation, with time studies, cost analyses and other valuable data. Write to:

THE YODER COMPANY
5499 Walworth Avenue • Cleveland 2, Ohio

YODER ROTARY SLITTING LINES

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Automatic Plate Handling

Automatic systems for handling ferrous or nonferrous plate and sheet are described in a 16-page bulletin, B 500, available from Noble Co., 1860 Seventh St., Oakland 20, Calif.

Economics of automation in sheet and plate handling, basic applications for automatic handling systems, and descriptions of typical floor-rail, overhead rail and radial-transfer systems are included. Layouts for feeding shears and similar equipment, stacking or transfer from conveyors, re-stacking from machines and other applications are shown.

Stainless Fasteners

An eight-page condensed guide to stainless steel fasteners normally carried in stock is available from Allmetal Screw Products Co., Inc., Garden City, N. Y.

Thirty-seven different types of standard fasteners are illustrated in the two-color brochure. Screws, nuts, bolts, washers, rivets, and government specification AN fasteners are included. Data pertaining to sizes carried in stock, threads, head and point styles, and grades of stainless steel is included.

Four-Lipped Seal

Information on the use of the Quad Ring, a unique four-lipped seal originated and manufactured exclusively by Minnesota Rubber & Gasket Co., 3630 Wooddale Avenue, Minneapolis 16, Minn., is contained in a new 12-page reference booklet published by the firm.

The booklet, illustrated with schematic drawings and specification charts, is intended as reference for product design and development as well as a guide in employing the ring in established applications, the company says. Included in the booklet, in addition to general information design, are data on design considerations for reciprocal and rotary applications, an engineering check list for packing installation and material requirements and a listing of all standard Quad Ring seal sizes.

Plumbing, Heating Valves

A new valve catalog Bulletin PH 58, is available from Dole Valve Co., Morton Grove, Ill.

It explains valve requirements of plumbing and heating systems, how the valves operate to meet these requirements and contains typical installations. Among the valves described are air and vacuum radiator venting valves for steam and hot water systems, water mixers, relief valves, flow control valves, solenoid valves and shower flow controls.

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . within the one, new NATIONAL AIROIL Dual Stage Burner.

45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed descriptions, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNER
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
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SPECIAL REFRACTORY SHAPES

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Spherical Bearings

Sealmaster Bearing Div., Stephens-Adamson Mfg. Co., Ridgeway Ave., Aurora, Ill. has released Bulletin 257, listing features and engineering data on its Spherco line of spherical bearings and rod ends.

Metal Alloys

Bulletin ASL 289 M, issued by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa., furnishes information on the result of a study of the heat treatment of Croloy 2¼ (Grades T22 and P22).

It details the yield strength, tensile strength, elongation, reduction of area and Brinell hardness at various annealing temperatures.

Vertical Pumps

A four-page, two-color catalog describing two types of vertical nonclog pumps is available from Economy Pump Div., C. H. Wheeler Mfg. Co., 19th and Lehigh Ave., Philadelphia 32, Pa.

These pumps are designed for sewage disposal, underpass service and drainage, and for applications in reduction plants and paper mills. The catalog shows three different dry pit installations, for medium-to-deep settings. A cutaway drawing of a typical pump is shown, illustrating mechanical features. Type FSN sentry-type pumps are also described. Metallurgy, performance data and size information are included.

Air Washing Systems

Control of slime and corrosion in air washing systems is the subject of a special service report published by Oakite Products, Inc., 142A Rector St., New York 6.

The report discusses the requirements for maintaining cleanliness in the water of an air wash system, and explains how its composition No. 55-M is used for this purpose. This material, combining germicidal and alkaline water treating ingredients, was designed to control the formation of slime and corrosion, and to inhibit the build-up of water scale. It is said to be readily and completely soluble in cold or hot water, and to present no foaming problem.

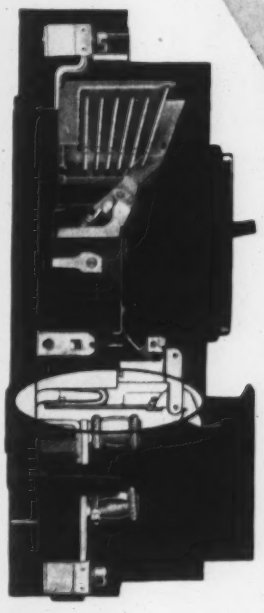
Engine Hour Meters

An engine hour meter, a precision-built, true-timing instrument which tells the actual hours and minutes of engine operation, is the subject of a new 12-page catalog, No. 600, made available by the John W. Hobbs Corp., Div. of Stewart-Warner Corp., 1826 Diversy Pkwy., Chicago 14, Ill.

Direct and alternating current hour meters, as well as flight hour meters which record air hours, are detailed as to installation and function. The meters—both pointer-type and direct reading—can be used on equipment powered by internal combustion engines, gasoline or diesel.

Chace THERMOSTATIC BIMETAL actuates another precision product

Westinghouse Tri-Pac CIRCUIT BREAKER



A Product of Westinghouse Electric Corp. Standard Control Division Beaver, Pa.

The Westinghouse TRI-PAC Circuit Breaker was developed to provide an economical high-interrupting capacity device for protection against short circuits, or fault currents, in applications delivering up to 100,000 amperes to breaker locations. This advanced-type breaker gives *triple* protection - (1) thermal time delay, (2) magnetic instantaneous, and (3) fusible current limiting. Developed by Westinghouse research engineers, this combination is greatly superior to fuses alone. Expensive fuse-replacement is reduced and single-phasing is eliminated.

With a world-wide reputation for reliability of products, it is natural that Westinghouse should rely on Chace to provide the all-important thermostatic bimetal breaker element. Precision-formed to the finest tolerances in the industry, Chace Thermostatic Bimetal is rigidly tested and inspected by experts with over a third of a century of exclusive bimetal specialization. With unerring and automatic precision, these vital elements initiate the breaking of the circuit when fault currents endanger valuable equipment. *Made* better to help industry's products *perform* better, Chace Thermostatic Bimetal continues to widen its usage in applications everywhere, year after year.

Remember Chace when you design for protection of valuable equipment or for temperature actuation or indication. Dependable Chace Thermostatic Bimetal is available in 28 types, in strip, coil, or completely fabricated and assembled elements made to your specification. (We do not manufacture complete controls or any other devices in competition with our customers.) Write today for new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal", containing interesting uses of bimetal and many pages of engineering data that may help you solve your product problems.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

FIGHT VIBRATION WITH VIBRATION

New twist in testing ...a torsional exciter

TORSIONAL testing *has* been done with rectilinear motion shakers by applying ingenuity in linking table to specimen. But here's a new MB exciter that produces torque *directly*. Its performance characteristics permit you to use it as a *calibrator* for torsional pickups and accelerometers . . . as well as for testing gyros and relays (as examples), or checking torsional vibrations of armatures, or determining torsional modes in various rotating parts.

OPERATING FACTS

At free-table, no load, this MB Model CA 1050 Exciter oscillates at up to 1600 cps without resonance in moving elements. It develops 110 ft. lbs torque, which produces angular accelerations as high as 1570 radians/sec/sec. Maximum total displacement is 45.°

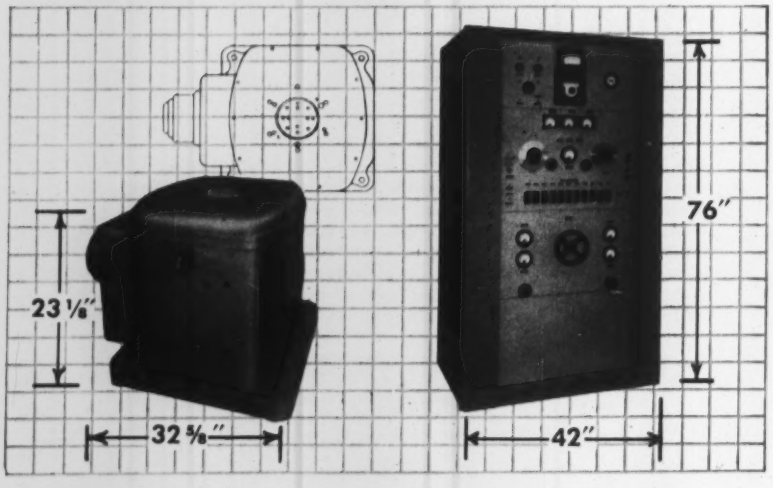
A MATCHED SYSTEM

Any one of several MB electronic power supplies drives the equipment, depending on the specific frequency range, power, and performance you want. The MB Model T51 Power Supply shown comes with automatic cycling controls if desired.

SEND FOR DETAILS

Technical data available. And for more information on how and where to use this unusual equipment, contact our staff of vibration specialists. You can't come to a better qualified authority on the subject . . . nor to one more willing to help on your specific vibration testing problems.

MB *manufacturing company*
A DIVISION OF TEXTRON INC.
1074 State Street, New Haven 11, Conn.
HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION



KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Stainless Steels

A four-page bulletin available from Armco Steel Corp., Middletown, Ohio, describes briefly the properties of 17-4 PH and 17-7 PH stainless steels.

Corrosion resistance, high strength, workability and hardenability at low heat-treating temperatures are some of the points brought out. Typical applications are listed in the Bulletin, designated P. O. 2557.

Optical Tooling

A 56-page manual covering the basic principles of optical tooling has been issued by Keuffel & Esser Co., Hoboken, N. J.

Photographs and drawings illustrate the major instruments and accessories used in optical tooling. Drawings show the optical principles used in applying the equipment.

Cylinder-Finish Tubing

Advantages of Rockrite cylinder-finish tubing for cylinders and other applications which require a smooth, close tolerance ID are described in a new technical bulletin, R7A, released by Tube Reducing Corp., Wallington, N. J.

Along with performance data and application facts, the bulletin explains the process of forming tubing.

Speed Reducers

Winsmith, Inc., Springville, N. Y., is offering a new illustrated catalog, No. SM-57, containing selection information for its Series ST torque arm and Series SF flange mounted speed reducers.

The catalog covers weights, dimensions, parts, ratios, and ratings, and service and selection factors. Both series are available in three sizes ranging from .63 to 8.82 hp with a ratio range from 7½:1 to 77:1, and a maximum output torque range from 816 to 7678 in-lb.

Plug Valve Bulletin

A 12-page illustrated lubricating manual for lubricated plug valves has been issued by the Walworth Co., 60 East 42nd St., New York.

The new manual describes the function of lubricants in lubricated plug valves and the essential properties of an effective lubricant. Information on how to select the right lubricant and how to apply it is presented in text and pictures. A two-page chart lists in alphabetical order more than 560 flow materials which lubricated plug valves service, and opposite each is its recommended lubricant number. The service range of each lubricant is presented in another chart along with a description of the lubricant and its temperature range.

For Consulting Engineers Turn to Page 174

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Filtration Systems

The Industrial Filtration Div., United States Hoffman Machinery Corp., 105 Fourth Ave., New York 3, has announced publication of a new four-page, two-color brochure describing the parts, principles and application of centralized filtration systems. The brochure is entitled FB-100.

Transmission Products

Jeffrey Mfg. Co., Columbus, Ohio, has available an 88-page catalog, No. 914, featuring transmission products and their uses in elevating and conveying machinery.

Descriptive information with drawings and tables of dimensions covers a variety of shaft collars, couplings, clutches, pillow blocks, take-ups, wheel hubs, gears, holdbacks, chains, and sprocket wheels.

Hydraulic Turbines

A 48-page bulletin, No. 02B7301A, describing the three principal types of hydraulic turbines has been released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

The bulletin's partial list of units, totaling nearly 14 million hp, includes some of the firm's largest installations in each category with cross sections and other engineering information. Illustrated reference is made to such recent projects as Kemano, Noxon Rapids, Shepaug, St. Lawrence, and Hiwassee.

Magnetic Drum Storage

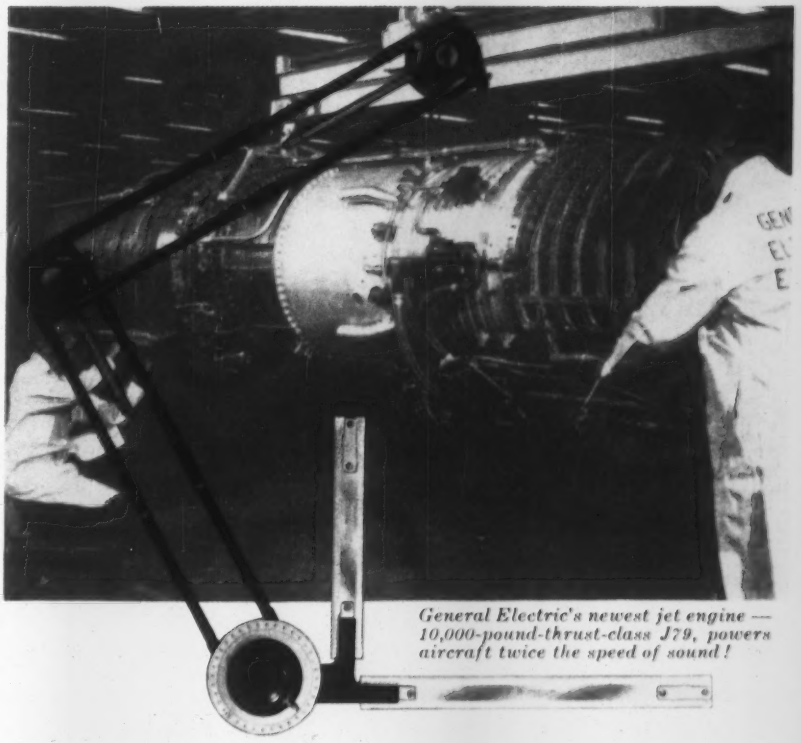
The capacities of random-access magnetic drum data storage are described in a six-page brochure published by Remington Rand Univac Div., Sperry Rand Corp., 315 Fourth Ave., New York 10.

In addition to outlining ten specific advantages of magnetic storage drums, the folder, No. U1062, describes the working of the drum in detail, including data on speed, capacity, the means by which a specific record is addressed and located on the drum, and the functioning of the magnetic drum within the file-computer system.

Packaged Air Conditioners

Packaged 7½ to 60 hp air conditioners with water-cooled condenser are described in a 26-page engineering catalog, No. EMS-5715WCC, available from Drayer-Hanson, 3301 Medford St., Los Angeles 63, Calif.

Designed for use in industrial or large commercial installations, the units offer, literature states, complete operating and application flexibility in a factory tested self-contained unit. Separate refrigeration circuits provide capacity control in multi-circuit units. General specification tables, ratings, electical current data, hot water coil heating capacities are illustrated.



General Electric's newest jet engine — 10,000-pound-thrust-class J79, powers aircraft twice the speed of sound!

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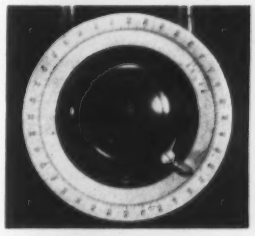

No need to hire extra draftsmen! Boardmaster drafting machines substantially increase drafting productivity — more than pay for themselves in greater efficiency and amount of work performed. Wherever important engineering developments occur, you'll find Boardmaster drafting machines on the job! Write for illustrated descriptive data.

100% visibility! No blind readings with Universal's famous Over-Arm Protractor. Largest dial, easiest to read, protected graduations.

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Etched Metal Parts

Photo-forming of metal parts for a great variety of industrial and commercial products is illustrated and described in Bulletin 90 just published by Superior Tube Co., Norristown, Pa.

Two processes—chemical etching and electrolytic etching—are described in the bulletin. In each case the metal strip or sheet is cleaned, coated with a light-sensitive emulsion, printed by exposure to light through precision glass printing plates and developed. In chemical etching the resulting pattern is etched with a suitable solution. In electrolytic etching it is etched by immersing in a bath and passing electric current from the piece to a negative electrode.

Carbon, Graphite Data

Application information, key characteristics and tabulated information on grades, sizes and properties of graphite and carbon products are presented in a new eight-page, two-color bulletin, Carbon and Graphite for High Temperature Applications, offered by Speer Carbon Co., St. Marys, Pa.

Carbon and graphite properties described include chemical inertness, low coefficient of expansion, low friction, ready machineability, high melting point, low density, high thermal conductivity and high resistance to thermal shock. Aspects of the manufacturing process, including duration of baking processes and mineral content of different grades, are discussed.

lubrication at high speeds

These LUBRIPLATE Lubricants provide the all-necessary lubrication for those modern, high speed machines operating up to 30,000 revolutions per minute.

LUBRIPLATE
No. 205—A superior and protective lubricant for anti-friction and plain sleeve grease type bearings, operating at speeds in excess of 5000 R.P.M. Widely used for lubrication of high speed bearings on woodworking machines, textile spindles, grinder arbors, etc.

LUBRIPLATE
Nos. 0, 1 and 2 are highly specialized light fluid type lubricants with high film strength. Their characteristics are excellent at both low and elevated temperatures. May be applied by conventional means.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Write for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. LUBRIPLATE DIVISION, Fiske Brothers Refining Company, Newark 5, N. J. or Toledo 5, Ohio.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Flushing Solvent

A folder available from E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa., provides data on a flushing medium said to eliminate downtime for cleaning. It is added to the lube or hydraulic system during machine operation, to loosen gums and sludges and hold them in suspension for draining in a routine oil change.

Developed originally as a cleaner primarily for hydraulic systems, uses for the solvent have since been extended into other areas of equipment maintenance. Many of these are covered by short case histories in the new publication.

Fast Action Valves

Homestead Valve Mfg. Co., Box 38, Coraopolis, Pa., announces Reference Book 39, Section 8, illustrating its Series 202 valves for air, water, gas, or oil.

The valves have a safety indicator that shows from a distance whether or not they are closed. Release of the handle from upright position automatically and fully closes the valve, the company states.

Feedwater Heaters

A two-color, 16-page bulletin on feedwater heaters has been published by Griscom-Russell Co., Massillon, Ohio, a subsidiary of General Precision Equipment Corp.

Bulletin 300 outlines the use of the heaters, their economies, and some of the problems of design. Present-day trends in powerplant equipment are discussed, and vertical and horizontal types of installation are described, as are the six most common functional designs.

Automatic Boilers

A four-page, illustrated bulletin, describing packaged automatic boilers for steam or hot water heating and hot water service, is available from Orr & Sembower, Inc., Morgantown Rd., Reading, Pa.

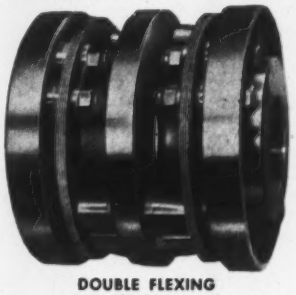
The unit is available in the 15 to 25 hp range for pressures up to 15 psi. It is integrally equipped with either oil or gas firing burners designed, constructed, fire-tested, insulated and guaranteed by the manufacturer.

Panel Instruments

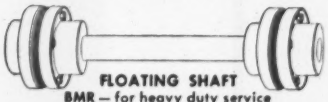
A bulletin covering the firm's long scale panel meters for specialty applications has been issued by Weston Electrical Instrument Corp., Newark 12, N. J.

Instruments are available in sizes from $2\frac{1}{2}$ to $5\frac{1}{2}$ in. for current and voltage indications as well as tachometry and temperature applications. In addition to long, 250-deg scales, the instruments are said to have excellent ballistic characteristics. Instrument movements are rubber mounted for shock resistance and embody spring-backed jewel construction.

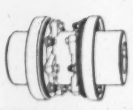
FOR MAINTENANCE FREE POWER TRANSMISSION
Specify
THOMAS
FLEXIBLE COUPLINGS



DOUBLE FLEXING
DBZ — for high speed, heavy duty drives



FLOATING SHAFT
BMR — for heavy duty service with excessive misalignment



DOUBLE FLEXING
AMR — for engine and medium speed drives

SINGLE FLEXING
SS — for engine-driven generator sets with out-board bearings

Thomas' 40 years of flexible coupling experience is at your disposal to help you meet ordinary applications or special variations for unusual cases.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES.

1 Freedom from Backlash Torsional Rigidity
2 Free End Float
3 Smooth Continuous Drive with Constant Rotational Velocity
4 Visual Inspection While in Operation
5 Original Balance for Life
6 No Lubrication
7 No Wearing Parts
8 No Maintenance

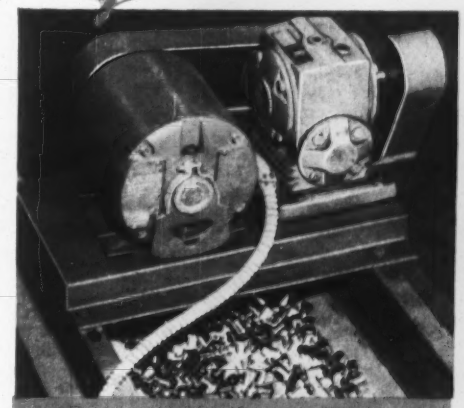
Write for Engineering Catalog 51-A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U. S. A.

Cost-wise design calls for STANDARDIZED BOSTON Gear SPEED REDUCERS

FROM STOCK!

BOSTON GEAR Standardized Speed Reducers take top-rating in any test. Why pay more, — why wait, for "specials?"



LASTING POWER ECONOMY, long wear, easy maintenance and quiet operation make Boston Gear Speed Reducers the practical choice for drives in materials handling equipment. A 100 Series Model T Reductor is used in the conveyor drive illustrated, where production of 4,000,000 lamp bases per day requires continuous, trouble-free operation.

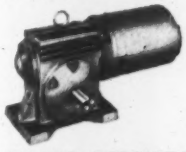
COST OF SPECIAL MACHINES IS MUCH LESS when designed around Boston Gear Standardized stock components. A 100 Series Model VMW Ratiomotor drives this automatic stripping and soldering machine for fuse plug lead wires. Assembly also includes standard stock Boston spur gears, rack, pillow blocks, pulleys, sheaves, and bushings.

1605
TYPES and RATIOS
FROM STOCK

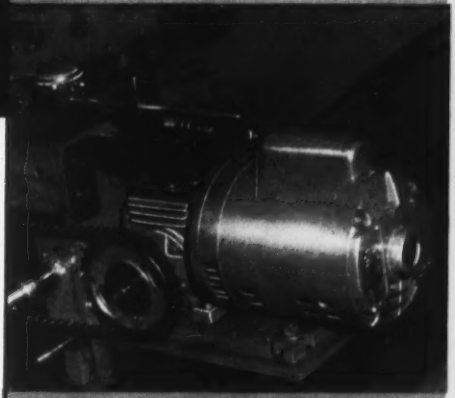
REDUCTORS

Ratios
1:1 to 3600:1
.004 to 50 HP

RATIOMOTORS
Output RPM .49 to 175



FLANGED REDUCTORS
Ratiomotor gear assemblies, sold without motor. You buy and attach your choice of motor.



INCREASED COOLING EFFICIENCY of the finned housings of Boston Gear Speed Reducers dissipates heat rapidly. This permits compact design and higher torque capacity, of special advantage in machine tool drives like the 100 Series Model M Ratiomotor illustrated, and where space is limited, or where high area temperatures prevail.

STANDARDIZED VARIABLE SPEED DRIVES, assembled from Boston Gear stock parts, simplify the design job, and save the time required to procure special equipment. The illustration shows a Boston Gear Variable Speed assembly with a Type TW Reductor, used with Boston stock sprockets and chain to drive conveyor belt of a heat-treating furnace.

Your nearby Boston Gear Distributor can furnish any model you need, *from stock.* His factory-trained specialists will advise you on selection to simplify design and assure maximum economy. Be cost-wise . . . STANDARDIZE and SAVE. Boston Gear Works, 66 Hayward St., Quincy 71, Mass.

Catalog No. 56 lists complete specifications — selection data

CALL YOUR **BOSTON Gear** DISTRIBUTOR

Per nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

7124 "OFF-THE-SHELF" TRANSMISSION PRODUCTS **FROM STOCK** — AT FACTORY PRICES — ASK FOR CATALOG
Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Pillow Blocks • Couplings

TAKE YOUR PICK!

Special Chromalox features solve 3 spot heating problems

FLEXING

Spring strain reliever of high temperature stainless steel for applications in which cartridge heater leads flex. High tensile spring, mechanically locked to heater, covers lead wires a distance sufficient to distribute stress.

MOISTURE

Moisture-resistant flexible brass conduit protects lead wires of cartridge heaters operating in presence of steam, water, oil and vapors. Also offers added protection from flexing, vibration and mechanical damage.

ABRASION

Flexible brass conduit protects cartridge heater lead wires against abrasion from other moving parts and from accidental mechanical damage. Safety factor where lead wires are exposed to machine operator.

FREE BULLETIN!

CHROMALOX ELECTRIC CARTRIDGE HEATERS

Get the full story. Call your Chromalox Representative or write today for Bulletin 850.

C-2101

Edwin L. Wiegand Company

7646 Thomas Boulevard • Pittsburgh 8, Pa.

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Well Water Systems

Layne & Bowler Inc., Memphis 8, Tenn, has published a four-page bulletin, No. 100, illustrating and describing applications of its well water systems, pumps, drilling equipment, and its allied services.

Photos showing the equipment at work in various industries are included.

Vacuum Impregnation

"Engineering Data on Vacuum Impregnation with PE No. 1," giving technical information on the process for pressure tight castings is available from Western Sealant Co., 9999 W. Jefferson Blvd., Culver City, Calif.

The six-page data sheet cites results in solving micro-porosity problems over the past 10 years. Cycles for batch and internal pressure impregnation, including simultaneous bonding of dissimilar materials, are outlined and diagrammed.

Heat Exchangers

Wolverine Tube Div., Calumet & Hecla, Inc., Detroit 26, announces its new booklet on design and cost comparison of heat exchangers.

It contains an analysis of the comparable costs between a plain condenser tube and the firm's type S/T shell and tube exchanger in common applications.

Valve Catalog

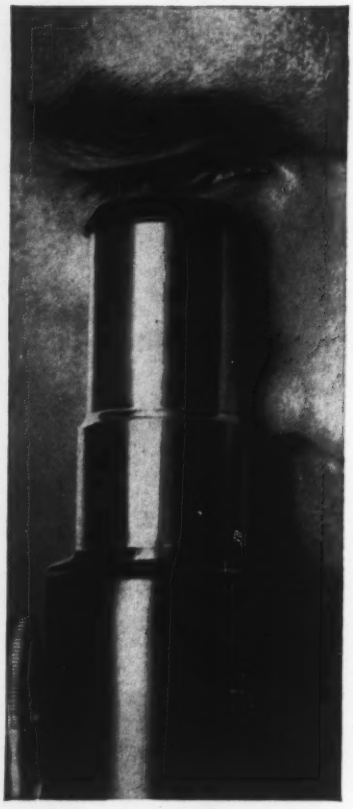
A valve catalog, No. 57, covering the firm's line of bronze and iron body valves, has been published by Fairbanks Co., 393 Lafayette St., New York 3.

The illustrated, 136-page, hard cover catalog includes patented renewable seat ring bronze gate valves, composition disk bronze swing check valves and solder end globe valves with drain. A modification of the 125 lb iron body gate valve—through-port design to reduce the turbulence and pressure drop in the flow through the valves—is illustrated in the sectional views of these valves.

High-Temperature Alloy

A new 24-page booklet containing the latest properties information on Multimet alloy is available from Haynes Stellite Co., Div., Union Carbide Corp., 30–20 Thomson Ave., Long Island City 1, N. Y.

The alloy has been used successfully in a number of aircraft and metal working applications in both the wrought and cast form, the company says. It recommends it for use at high stresses up to 1500 F, and at moderate stresses up to 2000 F. The booklet contains such properties information as stress-rupture strength, short-time tensile data, and fatigue and creep data. A separate section of the booklet describes methods for welding, forming, and machining the alloy.



This man is looking into your future

How does it look? Rosy? Free of cancer? You hope! But hoping isn't enough. Of every 6 Americans who get cancer this year, 3 will die because science still has no cure. It will take research . . . *lots* of research . . . to find that cure. And research, let's face it, takes money.

Instead of just standing by with hope, pitch in and help. Send your dollars . . . whatever you can afford . . . to the American Cancer Society today. You'll be bringing yourself and everyone else that much closer to a sure future. Send your check to "Cancer" in care of your local Post Office.

American Cancer Society

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Single Terminals

Drawings and specifications for a variety of standard single terminal feed-throughs and stand-offs are contained in a 12-page supplementary catalog No. 657-B, issued by Hermetic Seal Corp., Dept. ME, 29 S. 6th St., Newark 7, N. J.

Single terminals are produced in "Vac-tite" seals constructed by glass-to-metal chemically bonded compression process and in matched seals with metal and glass of matching coefficients of thermal expansion. Seals are listed in groupings according to types and sizes identified with specific part numbers. All are available hot tin dipped or in precious metal finishes.

Data Processing

Systems Div., Beckman Instruments, Inc., 325 N. Muller Ave., Anaheim, Calif. announces the release of a new brochure describing its Model 112 data processing system.

The eight-page brochure outlines the economics of automatic data processing in the present day well-instrumentated plant. The application of systems to present day process plant control and provision for future expansion is described. Providing an accuracy of ±.01 per cent the system exceeds the capabilities of many present day transducers, the company claims.

Flexible Shafts

Information and data on flexible shafts for remote control, power drive and coupling applications are given in a 14-page bulletin offered by S. S. White Industrial Div., 10 E. 40th St., New York, 16.

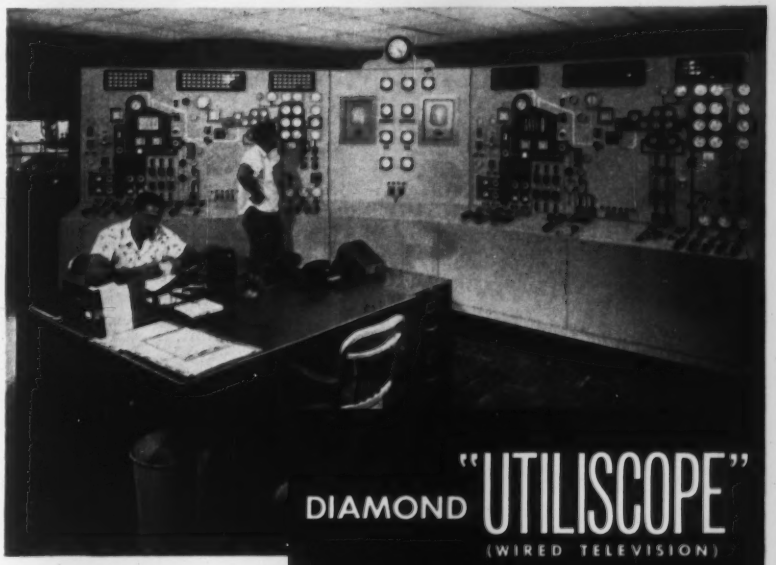
The bulletin contains extensive descriptions of flexible shaft functions, advantages, nomenclature, and characteristics. Factors to be considered by the user in choosing a shaft for a particular job are listed and discussed. A full-page torque table tabulates torque transmitted at different horsepowers and speeds. Separate sections describe lines of power drive and remote control shafts. Specification information is included on shaft casings, and metallic, fabric-covered, synthetic rubber-covered, and plastic-covered types are described.

Oscillographic Recording

A four-page folder describing and illustrating its 150 Series 1-, 2-, 4-, 6- and 8-channel oscillographic recording systems has been published by Sanborn Co., 175 Wyman St., Waltham 54, Mass.

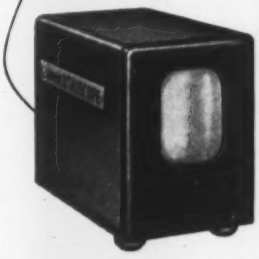
Included are descriptions and specifications of all basic assemblies; the 12 different presently available interchangeable plug-in preamplifiers; 2- to 8-channel output recording systems; and the new 6- and 8-channel mobile console systems and programmer for analog computer readout.

AUTOMATION IN POWER PLANTS



DIAMOND "UTILISCOPE"
(WIRED TELEVISION)
HEAVY DUTY EQUIPMENT FOR VISUAL INFORMATION

"UTILISCOPE" CAMERA



"UTILISCOPE" RECEIVER

The Diamond "Utiliscope" makes possible the ultimate in automation for power plant control. It enables the operator to see clearly anything that requires visual check. He no longer need depend upon indirect interpretations to know what is happening outside his range of vision.

The operator in the above photograph is watching the ITV image of the water level in two boilers . . . transmitted by "Utiliscope" cameras focused on Diamond Bi-Color water gauges. The water levels are easily and unmistakably read on the viewing screens. There can be no error . . . the level is shown correctly or there is no picture.

The Diamond "Utiliscope" is heavy duty equipment for power plant application. Other power plant uses are: watching flame conditions in boiler furnances, watching smoke emission from stacks, and watching remote entrances for intruders. Have you explored the "Utiliscope's" resources for saving money and improving operation? Use the coupon below for further information.

7800

DIAMOND POWER SPECIALTY CORP.
ELECTRONICS DEPT., P.O. BOX 57NN
LANCASTER, OHIO

Please send me without obligation a copy of bulletin showing how Diamond Industrial (Wired) Television will help me reduce costs and improve operations.

Name_____

Title_____

Company_____

Address_____

silent system

Piping systems in every industry have been made free from troublesome water hammer . . . free from dangerous surge pressures. *Silent* Check Valves eliminate these hazards by operating instantly when flow reversal starts or when flow is zero. *Write for descriptive Bulletins.*

Globe type for 3" to 24" lines.

Center-guided type for lines from 1" to 10".

WILLIAMS-HAGER

Silent CHECK VALVES

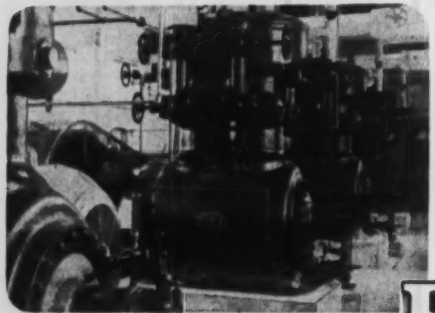
Write for Bulletins No. 654 on the Valves; No. 851 on Cause, Effect and Control of Water Hammer

THE WILLIAMS GAUGE CO., INC.
149 STANWIX STREET
2 GATEWAY CENTER PITTSBURGH 22, PA.
Our 71st Year—1886-1957

GOODYEAR'S NEW CHEMIGUM PLANT EQUIPPED WITH FRICK REFRIGERATION

This versatile plant, just completed at Akron, makes many types of rubber, latices and plastics. The big reactors, each holding 3000 gallons, are lined with glass; each is cooled with seven banks of glass-coated ammonia coils of the patented Frick direct-expansion design.

These coils, with their control system, enjoy a world-wide preference for use in chemical reactors.



Frick ammonia compressors at Goodyear's new plant in Akron, Ohio.

Four Frick compressors of 12 in. bore and 12 in. stroke, together with a 5 by 5 machine, carry the refrigerating load under automatic and semi-automatic controls.

When you want the most durable and efficient refrigerating equipment, whether for air conditioning, process work, ice making, quick freezing or other cooling service, specify "Frick". Literature and estimates on request.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U. S. A.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Super-Strength Steels

A booklet describing the characteristics of and uses for super-strength structural steels possessing minimum yield strengths from 55,000 to 150,000 psi has just been published by Climax Molybdenum Co., 500 Fifth Ave., New York 36. This booklet, reviewing 15 different grades of steel produced by 7 different companies, was prepared in cooperation with the American Iron and Steel Institute, U. S. firms producing these steels and several welding companies. It contains technical information and tables describing the composition, mechanical properties, heat treatment, corrosion resistance, machineability, size limitations and end uses of these relatively new materials.

Limit Controllers

A four-page folder describing its Models 561 and 562 limit controllers is available from Daytronic Corp., 216 S. Main St., Dayton 2, Ohio.

The new folder describes in detail the use of limit controllers for automatic control of weight, size, force, thickness, pressure, flow, acceleration, stress, strain or other physical quantities. A number of suggested applications are shown. Specifications of standard models and description of selectable options are given.

Heating Estimate Guide

A design data booklet to assist in layout of efficient heating systems for factories, auditoriums, gymnasiums and other large area buildings is being made available by Carrier Corp., Syracuse 1, N. Y.

Entitled "Design Data Heating" the 71-page manual contains engineering information for determining proper application and capacity requirements of unitary or central plant systems. Subjects covered in the guide include survey, design conditions, transmission coefficients, heat loss calculations and piping sizes.

Oilless Bearings

A catalog, No. 240, covering its entire line of self-lubricating oilless bearings for roller conveyors and screw conveyors has been published by Arguto Oilless Bearing Co., 149 W. Berkley St., Philadelphia 44, Pa.

The 24-page, illustrated catalog includes specifications, list sizes, and operating characteristics of standard conveyor roll bearings as well as self-sealing, free draining and conical bearings for use on belt, live roller, gravity roller, and special conveyors. Non-contaminating and abrasion resistant screw conveyor hanger bearings are detailed in a section which includes dimensional and installation data for all types of screw conveyor hanger bearings.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Forging Facilities

A 47-page pictorial tour of its plant is offered by National Forge and Ordnance Co., Irvine, Warren Co., Pa.

The catalog, designated NFO-20, shows the company's forging facilities utilized in the production of products ranging from propeller shafts for marine and aircraft to heavy bored tubing for power plant builders.

Sump, Nonclog Pumps

C. H. Wheeler Mfg. Co., Electric Pump Div., 19th and Lehigh Ave., Philadelphia 32, Pa., announces five new catalogs on pumps.

Catalog E-100 covers general service sump pumps; E-101, 3 and 4 in. nonclog sump pumps; F-100, vertical nonclog pumps; F-101, 3 and 4 in. horizontal nonclog pumps; D-100, type SDV general service pumps.

Pin Engineering Data

Aviation Developments Inc., Box 391, Burbank, Calif., announces a brochure on its line of 5440 single-acting self-locking quick-release pins. It contains information on materials, finishes, head styles, dimensions and load factors.

Diagrams are provided for positive callout procedures. The bulletin is designated ADI 1268-257.

Industrial Burners

Coen Co., 40 Boardman Pl., San Francisco 3, Calif., has issued a new 12-page catalog on its Fyr-Compak industrial burners for gas or oil or combination firing.

They are complete with combustion control, safety equipment and forced draft air system. They range in capacity from 4000 to over 60,000 pph steam. The catalog includes views of installations in plants of leading industrial plants, hospitals and utility companies.

1-Ton Fork Truck

A four-page folder, illustrating and describing its 2000 lb-capacity fork truck has been published by the Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

The electric-powered truck, designated F-38T2, has maximum lift speed of 72 fpm, for rapid top travel speed of $6\frac{1}{2}$ mph, and short turning radius of 360-deg steering.

Use a CLASSIFIED ADVERTISEMENT

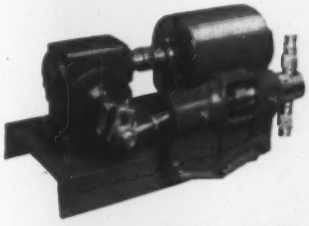
For Quick Results

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ±1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.



PAY LESS, GET MORE!

Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

Request Bulletin 1106-2 for complete data. Write to PROPORTIONEERS, INC., 382 Harris Avenue, Providence 1, Rhode Island.

PROPORTIONEERS, INC.
DIVISION OF
B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND
METERS FEEDERS CONTROLS

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Meters, Controls

Instruments introduced within the last year have been included in new eight-page edition of Bailey Meter Company's annual bulletin, G15-1.

Applications, ranges, and detailed literature references are given for the firm's line of transmitting, recording, indicating, and controlling instruments. It is available from the company, 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Air Conditioning

A new general products catalog containing 150 photos and brief descriptive copy is announced by Trane Co., La Crosse, Wis.

The 32-page catalog has information on new and redesigned products, including the duplex compressor CenTraVac water chiller, self-contained air conditioner, induction UniTrane room air conditioner, multi-zone climate changer air handling unit, wall-fin heating unit, Torrivent heating unit, unit ventilator heating and ventilating unit and shelving.

Vibration Belt

A one-page catalog sheet on the Vibrasorb V-belt said to reduce vibration and noise by absorbing it before it reaches the machine has been published by B. F. Goodrich Industrial Products Co., Akron, Ohio.

The catalog sheet explains how the patented belt solves vibration problems for air conditioning units, forced air furnaces, window and attic fans, and other belt driven appliances. Information needed for drive design is included.

Air, Vacuum Pumps

Leiman Bros., Inc., 102 Christie St., Newark 5, N.J., announces a 16-page catalog, No. 757, describing rotary positive air and vacuum pumps, gas boosters and air motors.

Details of construction, dimensions, capacities, performance curves, installations are given. Included are 2 and 4 wing types; fan-cooled, water-cooled and new radiator air-cooled models; motor driven units; direct-coupled and belt-driven models; integral pump and motor; automatically controlled tank units; and accessories.

Skew Loader

A data sheet, No. 570, covering its new skew loader has been issued by Gear-O-Mation Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. The loader is described as an automatic positioning unit that aligns center-bored parts for easy manual pickup on skews for heat treating. The two-page data sheet has a large photo of the equipment and a description of its operation and application.

Water Control Gates

S. Morgan Smith Co., York, Pa., announces Bulletin 163, describing water control gates.

The 16-page technical bulletin outlines the several basic types of gates and their applications. Discharge curves are shown for preliminary sizing, and general specifications are included. Sectional drawings, standard dimensions and field photographs provide information on design characteristics and general construction.

The ADDED Ingredient... KNOW-HOW
...HAS MADE
DUDEK & BOCK
THE Leader!
WIRE FORMS
SPRINGS
METAL STAMPINGS
In Industry, in homes, farms and shops, you'll find daily, living proof that D-&-B's KNOW-HOW pays out in EXTRA performance. Rely on expert engineers for parts that meet your exact needs and save you MONEY! Get Wire Forms, Springs and Stampings that are easily assembled . . . that withstand stress . . . and perform under the most trying conditions!
SPEEDY DELIVERY
WRITE — WIRE — or PHONE for Estimates and Delivery Dates
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DUDEK & BOCK
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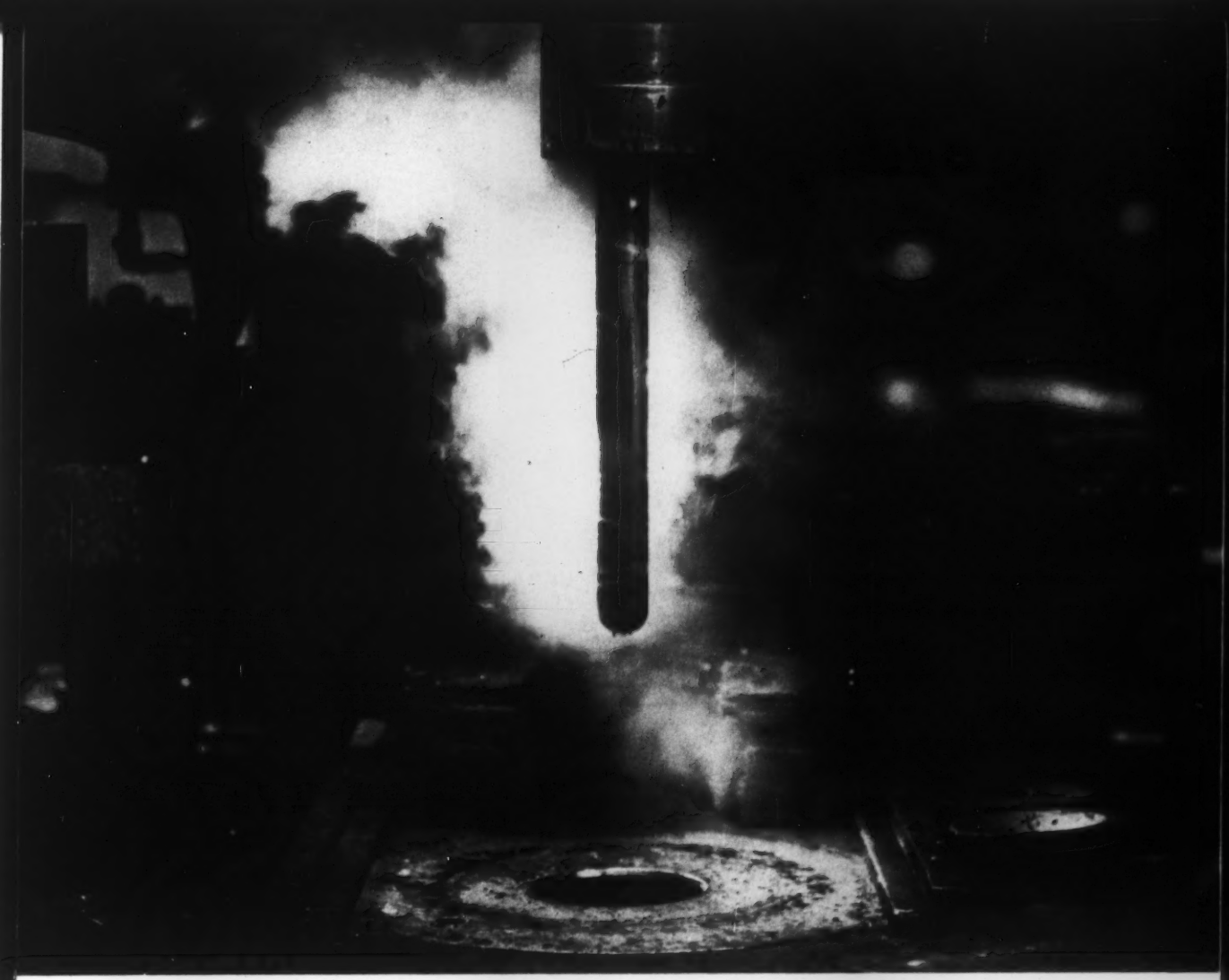
Phone: DICKENS 2-1020
4014 W. Grand, Chicago 51, Ill.

SPRAY NOZZLES
CHOICE OF brass, steel, stainless steel, monel metal and hardened steel.
CAPACITIES from 0.08 GPM to 38.0 GPM
already designed
CHOICE OF brass and stainless steel with inserts of stainless steel and tungsten carbide
CAPACITIES from 0.10 GPM to 14.1 GPM
TUNGSTEN CARBIDE INSERT
to meet your specifications
When you check Spraying Systems' Catalog 24 . . . the range of "standard" spray nozzle types, capacities and materials is so great in number . . . that it is rare when you cannot find a nozzle already made to meet your specifications, no matter how "special" your specifications might be. With Spraying Systems you gain the advantages of special nozzle performance characteristics at lower cost standard nozzle price. For complete information write for your free copy of the forty eight page reference Catalog 24.
SPRAYING SYSTEMS CO.
3265 RANDOLPH STREET • BELLWOOD, ILLINOIS
ADVANCED SPRAY NOZZLE DESIGN FOR NEW DIMENSIONS IN CONTROL AND PERFORMANCE



Tough 2½" diameter mandrel at Rc 44 on 1150 ton brass extrusion press. Scovill Manufacturing Co.

Mandrel of HALCOMB 218 retains toughness and hardness at hot work temperatures...

This mandrel is made of Halcomb 218—a tough, air-hardening hot work steel. Halcomb 218 is suitable for tools like this which require a higher degree of toughness at moderately elevated temperatures than is obtainable with the tungsten types of hot work steels. And Halcomb 218 *retains both* its hardness and strength at these temperatures.

For example, at a hardness of Rc 44, Halcomb 218's Charpy Impact Strength is 33 ft-lbs at 500F. And it will retain this hardness after 1 hour, after 10 hours and even after 100 hours at temperatures up to 900F.

Properties like these cut tooling costs. The mandrel shown above is good for 1200 pushes, for example, and even then all it needs, usually, is repolishing before being used again.

Halcomb 218 is particularly useful for all hot work operations on which drastic coolants are used. It even resists breaking very successfully when water cooled in operation. If these sound like advantages you can use, call your local Crucible representative for more complete data. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor—Railway & Power Engineering Corp., Ltd.

A cast rod of pure uranium,

diffusion coated with silicon to give an impurity gradient,

is heated and swaged to get fine-grained structure.

At 650° a few fine grains in the center abruptly grow . . .

and continue to grow until a barrier is reached. Single crystals are cut from the rod.

Leadership→Uranium SINGLE Crystals... 99.992% Pure

The purest uranium in the world is obtained as clusters of electrolytic deposits like that shown in the background. The pure, clean metal is valuable in itself for research. Still more valuable are the single crystals made from such metal. Argonne metallurgists developed the methods for making ultra pure uranium castings and the single crystals, opening the way for improved uranium technology.

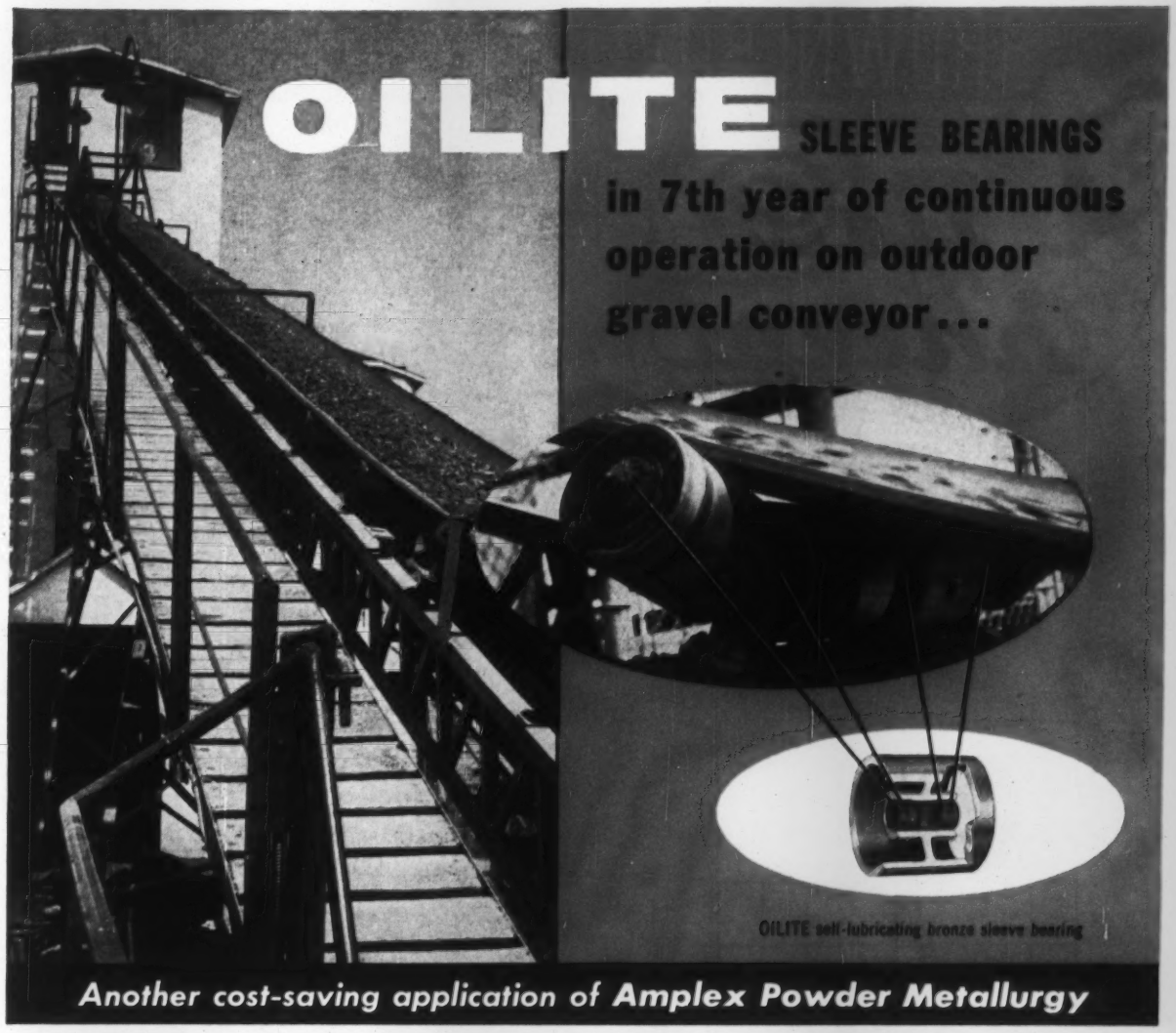
Argonne
NATIONAL LABORATORY

Operated by the University of Chicago under a contract with the United States Atomic Energy Commission

PROFESSIONAL PERSONNEL OFFICE
P. O. BOX 299 • LEMONT, ILLINOIS

Inquiries Invited

MATHEMATICIANS • PHYSICISTS • METALLURGISTS • CHEMISTS
HEALTH PHYSICISTS • INDUSTRIAL HYGIENISTS
ENGINEERS: ELECTRICAL, CHEMICAL, METALLURGICAL, COMPUTER, PLANT, MECHANICAL, ELECTRONICS


OILITE SLEEVE BEARINGS
in 7th year of continuous operation on outdoor gravel conveyor...
OILITE self-lubricating bronze sleeve bearing

Another cost-saving application of Amplex Powder Metallurgy

No seals protect these OILITE bearings from sand, gravel, grit. On the two center rollers, no additional lubrication is possible. Yet this OILITE-equipped outdoor conveyor has been in continuous operation under extreme weather conditions for seven years—*without replacing one OILITE bearing.*

That's some record! J. Cooke (Concrete Blocks) Ltd., of Aldershot, Ontario, one of Canada's largest producers of concrete blocks, operating twenty of these sand and gravel conveyors, has proved the long wearing, money saving qualities of OILITE bearings.

No wonder all twenty conveyors are 100% OILITE equipped. The company says, "We wouldn't use any other kind."

What interests you? Longer product life—greater efficiency—lower cost? All three? Maybe Amplex has the answer.

Write for detailed information about Amplex powder metal components—OILITE Bearings, Parts, Filters. Or call your nearest engineering representative listed in the yellow pages under "Bearings—OILITE."

CHRYSLER OILITE PRODUCT

*OILITE is a registered trademark

*Only Chrysler Makes Oilite**

AMPLEX DIVISION

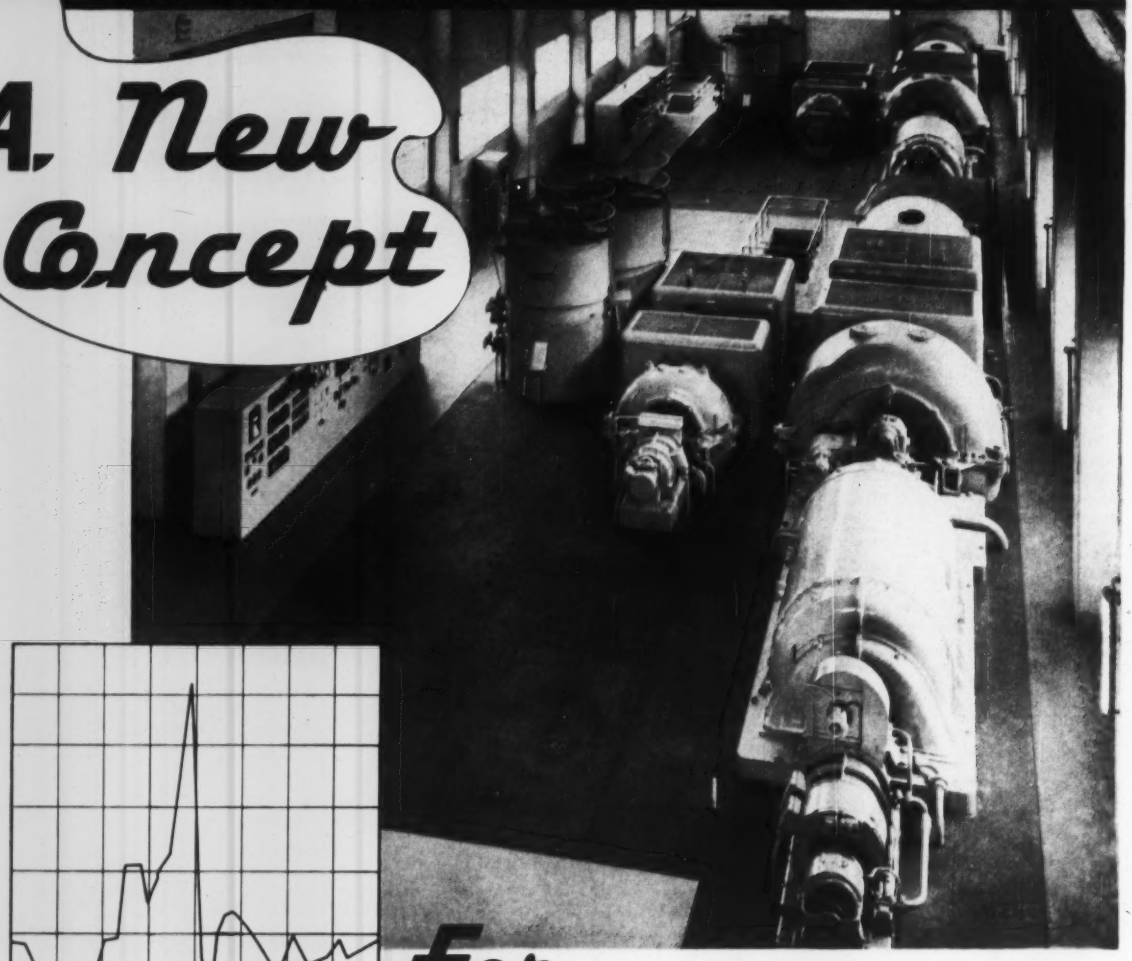
CHRYSLER CORPORATION • DETROIT 31, MICHIGAN

Representatives and dealers located throughout the world

BEARINGS • FINISHED MACHINED PARTS • PERMANENT METAL FILTERS • FRICTION UNITS • FERROUS AND NON-FERROUS METALS

BROWN BOVERI GAS TURBINES

A New Concept



For Peak Loads

DEPENDING on the load, either the 7,000 kW single shaft or the 25,000 kW non-regenerative cycle Brown Boveri Gas Turbine provide the answer to the rigid demands of peak load service. *They can be put on the line in 20 minutes or less.*

Their on-the-job performance records—in over 60 power plants throughout the world—conclusively indicate not only economy of operation but sizeable savings in initial costs.

If your problem is *peak* or *base* load service, it will pay you to investigate Brown Boveri Gas Turbines.

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

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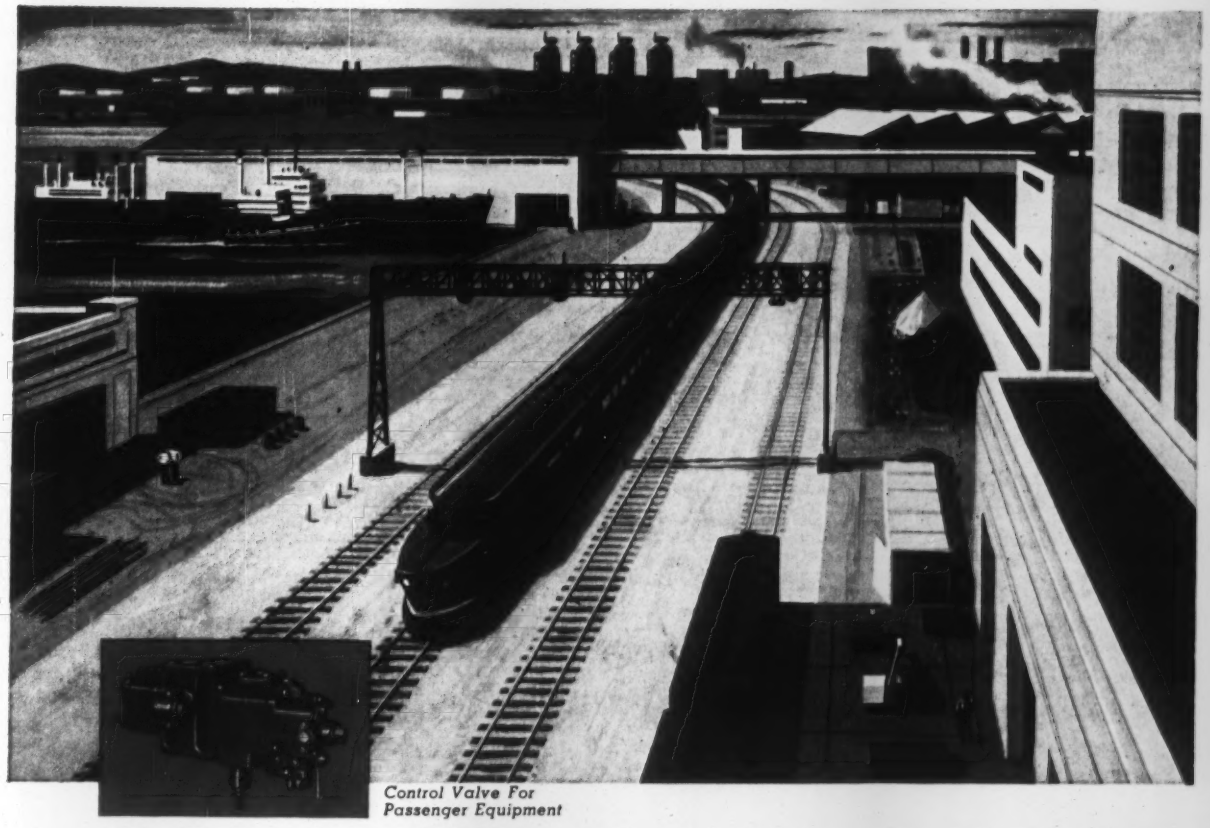

Control Valve For Passenger Equipment

Making and Moving Goods Faster, Better, Cheaper, Calls For IMAGINATIVE ENGINEERING

How often is Imaginative Engineering the Key to YOUR problem?

In the constantly moving world of modern industry, the research and engineering of The New York Air Brake Company plays many and varied roles FOR YOU! Trains and planes, ships, trucks, conveyors and pipes — all engage the objective thinking of New York Air Brake men, who apply their specialized talents in pneumatics, hydraulics and high vacuum to improving your products, speeding your schedules and lowering costs.

The air brake systems of modern freight trains and tomorrow's sleek streamliners rank high in the art of applied pneumatics. Here are intricate design, precision craftsmanship and rugged dependability, combined to provide velvet smooth deceleration and fingertip control for trains weighing thousands of tons.

Liquid handling Pumps, bearing the Circle NY, run the gamut of services, ashore and afloat. From Centrifugals and Turbines to Rotary Piston and Heliquad Pumps, there are types and sizes "to handle anything that will flow through a pipe."

Hydraulic equipment, produced by Divisions of The New York Air Brake Company, provides Fluid Power for leading aircraft, advanced type missiles and rockets, mobile equipment of all sorts, as well as machine tools and highly automated production machinery.

High Vacuum has helped make possible the spectacular advances in Electronics, Nucleonics, Metallurgy, Refrigeration, Air Conditioning, Biochemistry and other fields. Kinney High Vacuum Pumps, High Vacuum Systems and Imaginative Engineering make significant contributions to these advances.

WATERTOWN DIVISION
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Railroad Air Brake equipment of all types; STRATOPOWER Hydraulic Pumps and Motors for Aircraft, to 5000 psi for operation to 400° F.

KALAMAZOO DIVISION
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HYDRECO Hydraulic equipment for industrial and mobile applications. Gear and Dual-Vane Pumps and Motors to 2000 psi, to 120 gpm, to 120 hp. Control Valves to 2000 psi and 150 gpm. Cylinders: Telescopic, Single and Double-acting to 10" diameter, strokes to over 20 ft.

AURORA PUMP DIVISION
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AURORA Centrifugal Pumps to 8500 gpm and 600 ft. heads. APCO Turbine type Pumps, 5 to 150 gpm, heads to 700 ft. Condensate Return Units 800 to 100,000 sq. ft. radiation.

KINNEY MFG. DIVISION
Boston, Mass.

High Vacuum Mechanical Pumps, single stage, 13 to 780 cfm, pressures to .01 mm Hg; two stage, 2 to 46 cfm, pressures to .0002 mm Hg; Mechanical Booster Pumps, 30 to 5000 cfm, pressures to .0001 mm Hg. Rotary Liquid Handling Pumps to 3000 gpm.

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Complete KINNEY Vacuum Systems—Vacuum Furnaces (Arc, Induction or Resistance), Evaporators, Optical Coaters and Metallizers, TV Tube Aluminizers; Oil Diffusion Pumps, Gages, Valves and Oils.

Write for your copy of Bulletin 1102A which pictures the facilities The New York Air Brake Company offers you.

THE NEW YORK AIR BRAKE COMPANY

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Westinghouse Men of Vision Plan New Atomic Fleet

First it was the *Nautilus*. Now Westinghouse is working on nuclear power plants for more units in the growing U.S. atomic fleet. Here is a chance for engineers to put their present knowledge to work on the ground floor of a new and growing industry . . . where they will be helping to guarantee the future of their country at the same time they are guaranteeing their own future.

Engineers in Westinghouse Atomic Power have assignments covering a broad range in the field of nuclear propulsion components . . . from specifications through manufacturing and test follow-up . . . to installation and operations.

No delay for security clearance; you can start working at once. Relocation allowances . . . and unique housing bureau will help you relocate in Pittsburgh, the renaissance city of America. Automatic salary increases, in addition to merit increases.

No prior atomic experience is necessary. If you have a background in pumps, valves, heat transfer, fluid systems, technical procurement, or manufacturing engineering liaison, send résumé to Mr. J. D. Batey, Westinghouse Electric Corporation, Dept. MEK-107, Box 1047, Pittsburgh 30, Pa.

Westinghouse

FIRST IN ATOMIC POWER

. . . where atoms go to sea

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SPECIAL
ABOUT
LJUNGSTROM'S®

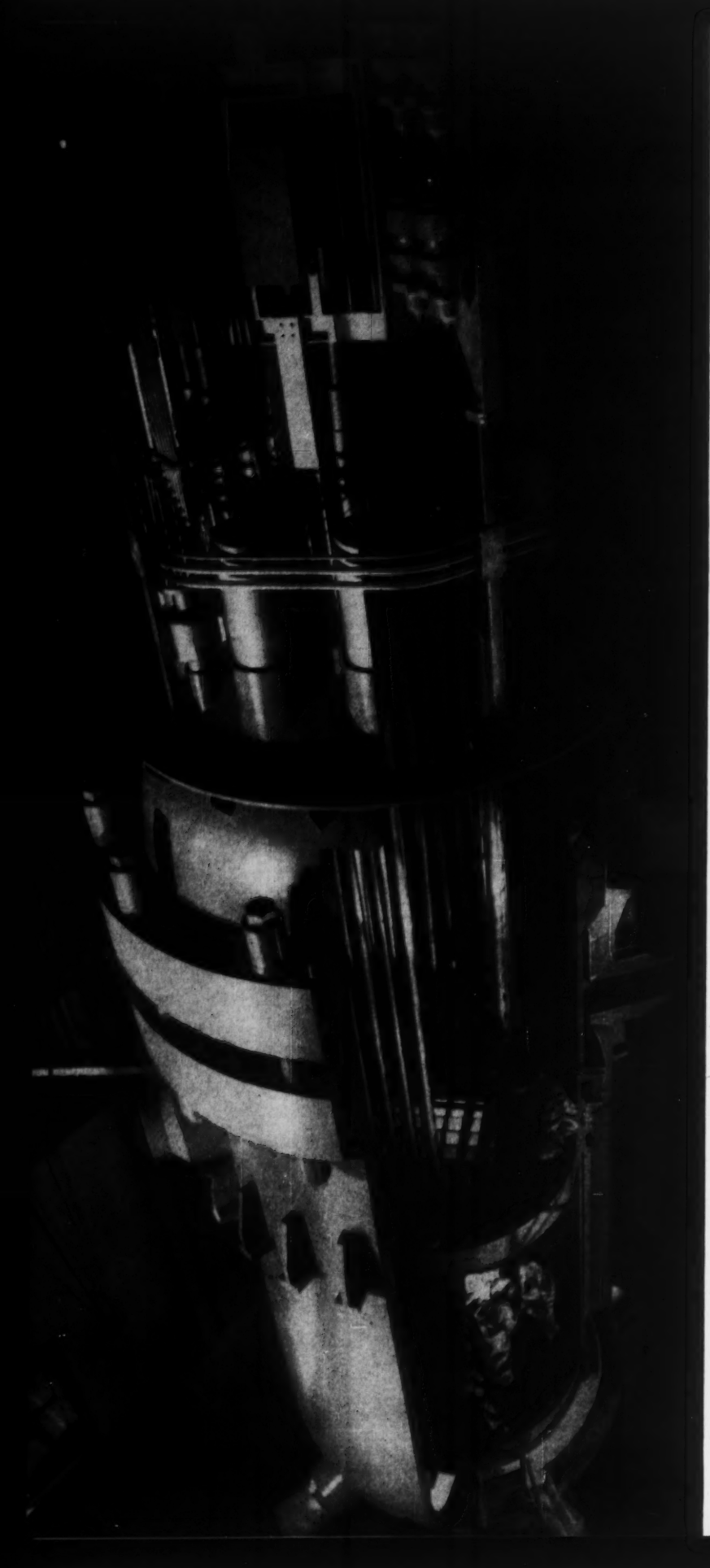
easy maintenance features

Ljungstrom maintenance is fast and easy because it, too, is a "designed-in" function of the preheater. Necessary work has been foreseen by such money-saving features as:

- Self-cleaning action that loosens deposits by expansion and contraction—coupled with high-velocity soot blowers for daily in-operation purging.
- Cold-end heating elements are factory packed—can be easily replaced, or reversed when one edge starts to thin...which is vital for cold end service and essentially doubles surface life.
- Large inspection port and vapor-proof light to permit observation of heating surface, even during operation.
- Trained service engineers make periodic visits and are available on short notice for special problems.

That's why seven out of ten installations are Ljungstrom. For the full story write for our 38-page manual.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.



Designing reactor for nation's first full-scale nuclear power station

A nuclear power plant must be designed to safely produce maximum power. Because the nuclear reactor can produce almost any level of heat output, its limitations must be set by the ability of its cooling system to remove the power.

At Bettis Atomic Power Division, one of the key engineering problems in the design of the Pressurized Water Reactor was the development of fuel elements which could handle maximum heat production while avoiding melt-down or burnout. Reactor thermal designers used a combination of analytical and experimental efforts to determine the safe operating level of a reactor. Computations of melting and phase transformation temperatures, as well as the temperature difference between the temperature of the bulk water flowing past a fuel element and the surface temperature of the cladding, were necessary.

Of course, thermal and flow problems are also intimately connected with the mechanical design of the reactor. To mention only one example, stress problems are generated by the high non-linear temperature gradients in the fuel elements and structure. Analytical treatment of the thermal stresses in combination with pressure and mechanical stresses is particularly difficult because of complex structural geometries and non-uniform radiation heating. Other design problems include materials, operational reliability, warpage, tolerances, alignments, and maintenance.

This is only one example of the challenging opportunities available at Bettis Atomic Power Division. If you are interested in a career with the new and expanding nuclear power industry, send your résumé to: Mr. M. J. Downey, Bettis Atomic Power Division, Westinghouse Electric Corp., Box 1468, Dept. A204, Pittsburgh 30, Pa.

◀ This mockup of the pressurized water reactor for the nation's first full-scale civilian nuclear power station rises four stories tall complete to closure head and supporting structure. It was constructed at Bettis Atomic Power Division to assist scientist and engineers in the mechanical design of the actual power plant. Under Atomic Energy Commission sponsorship, the Shippingport Power Station will be operated by the Duquesne Light Company some time in 1957.

BETTIS ATOMIC POWER DIVISION

Westinghouse

finest quality!

Precision "O" Ring quality is maintained by over 100 inspections and quality control tests. As a final step, "O" Rings are rigidly inspected to assure "O" Rings that are:

1. Free of flash. 2. True to size. 3. Meet the specifications.

Have a sealing problem? You'll find the answer at Precision. There's a Precision engineer ready to help you with "O" ring specification and with product design.

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"O" Ring and Dyna-seal Specialists

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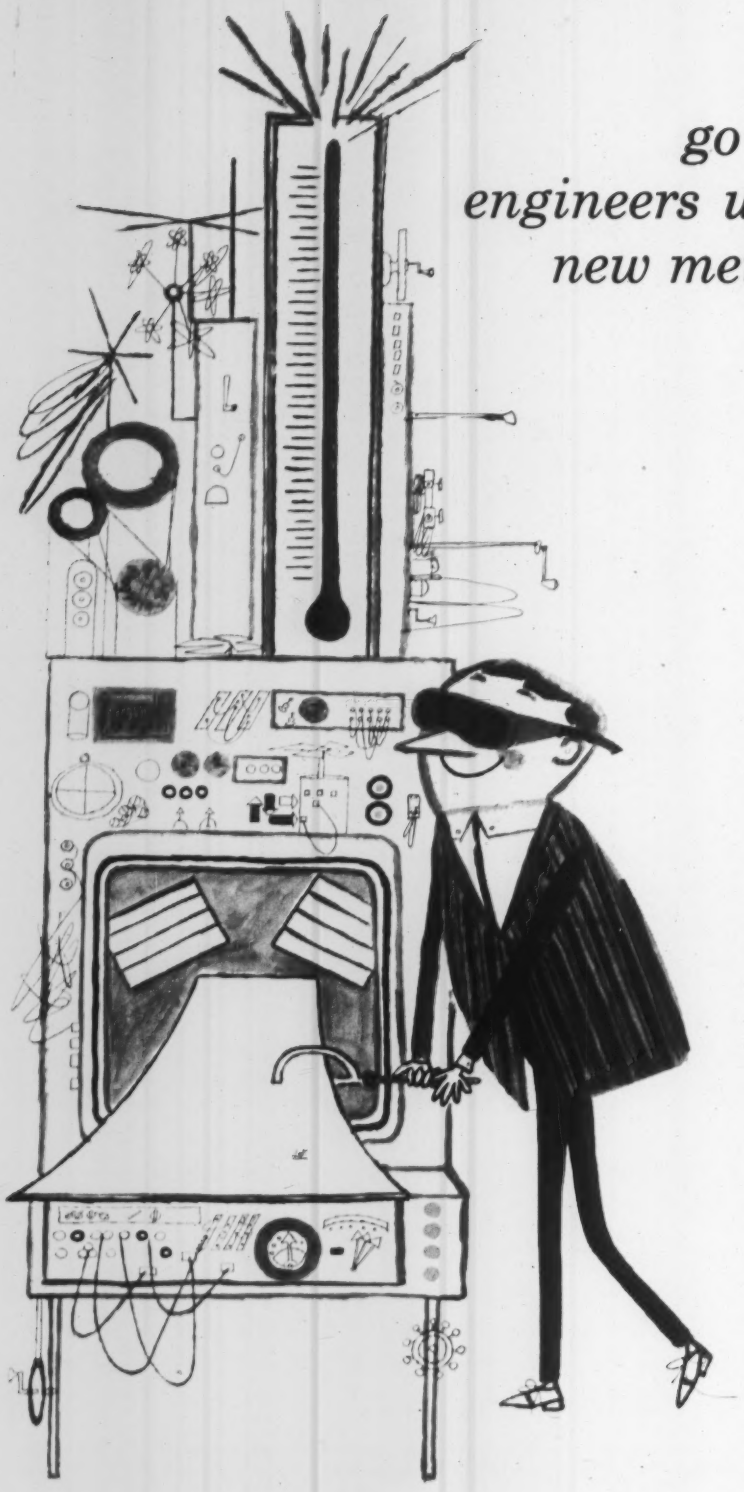

How to make the most of your engineering career

ONE OF A SERIES

go where engineers use new materials, new methods

One of the best ways to get a head start on the future is to gain *early* experience in the use of revolutionary new materials, new alloys, new fuels, new processes.

Boeing, by the very nature of its pioneering work, is among the first companies in the world to work with the newest materials—with metals, for instance, able to withstand the sudden loads and extreme temperatures encountered in missile operations and supersonic flight.

You could speed up *your* engineering progress by getting this kind of ground-floor experience—at Boeing. You'll find the work intensely interesting, and you'll be gaining experience that will be increasingly valuable to you in the years to come.

If you're looking to the future, get in touch with Boeing, where you'd enjoy many career advantages, including assignments in such years-ahead fields as jet-powered airliners, advanced guided missile weapon systems, supersonic flight and inertial and electronic guidance.

Boeing has openings, now, for scientists, and for engineers of ALL categories.

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AUTOMATION

IN HARDBOARD PRODUCTION

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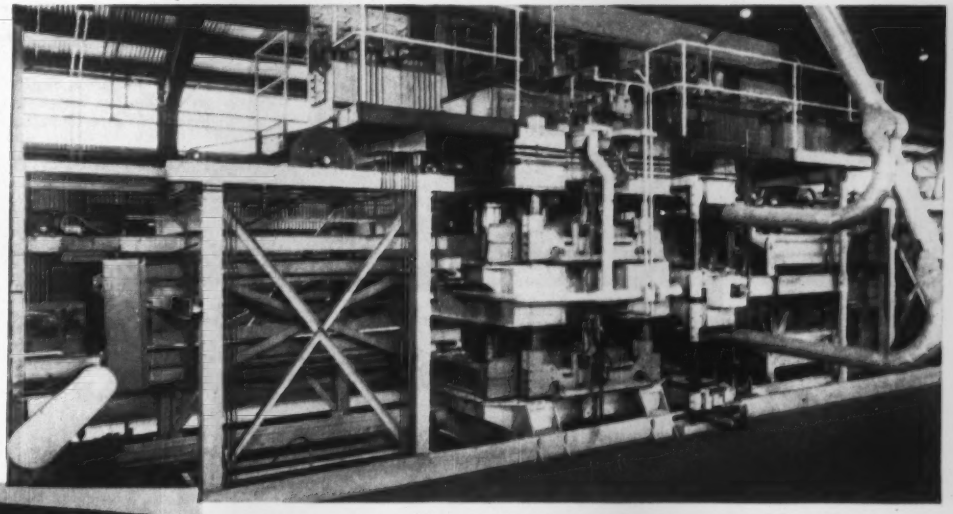
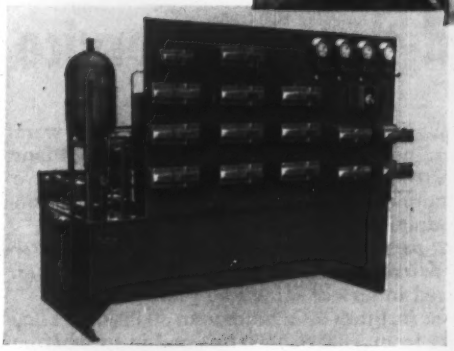
METALWORKING is not alone in using Vickers Hydraulics for Automation

REDUCES COSTS • IMPROVES UNIFORMITY • PROVIDES FLEXIBILITY



Prepress area of automatic hardboard plant designed and built as a package unit by the Industrial Development Company, Tacoma, Washington for Columbia Hardboard Company, Inc.

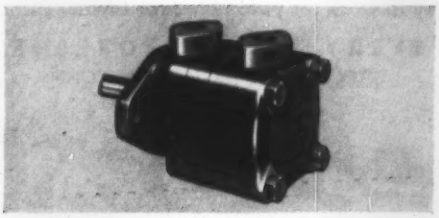


This Vickers Custom-Built Power Unit is individually designed to meet specific needs. It assures dependable performance, improves and simplifies design, reduces installation time and cost, and makes servicing easier. Write for Bulletin 52-45.

Reported to be the most highly automated in the wood products industry, this plant produces 60,000 sq ft of "Cedawood" per day (½" basis).

Seven Vickers Custom-Built Hydraulic Power Units play an important part in this performance; four are shown (in the photograph above) mounted on the platform directly above the prepress. The other three operate a series of automatic transfer systems in various parts of the plant. The transfer drives also use Vickers Vane Type Hydraulic Motors, which provide easily controlled variable speed for synchronizing various operations and for overload protection.

The use of hydraulic variable speed drives makes it easy to vary production rate, flakeboard thickness (⅛" to 1"), and type of product. Additional features are: accurate control, simplicity of installation, and low maintenance. For further information about the many benefits you get from Vickers Hydraulics, ask for Bulletin 55-67.



The performance-proven Vickers Balanced Vane Type Hydraulic Motor is an economical, efficient, and compact means of providing variable speed rotary power. It can be used for reversing service and can be stalled under load without damage. Write for Bulletin I&M-5103.

7834

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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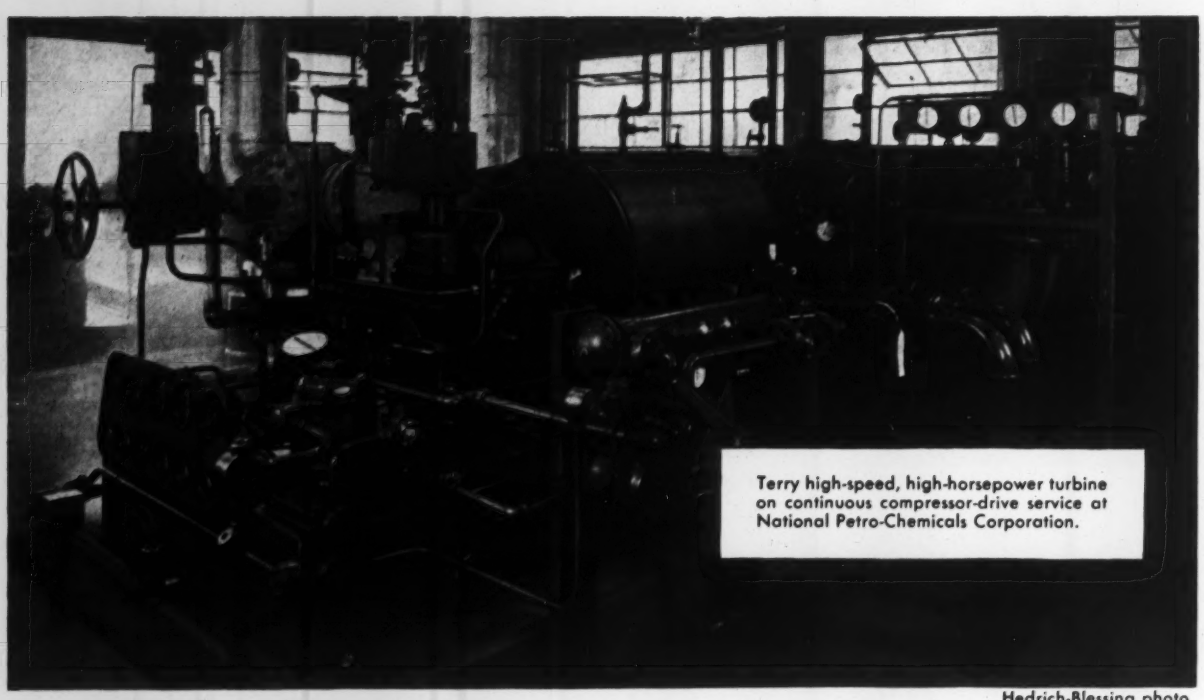
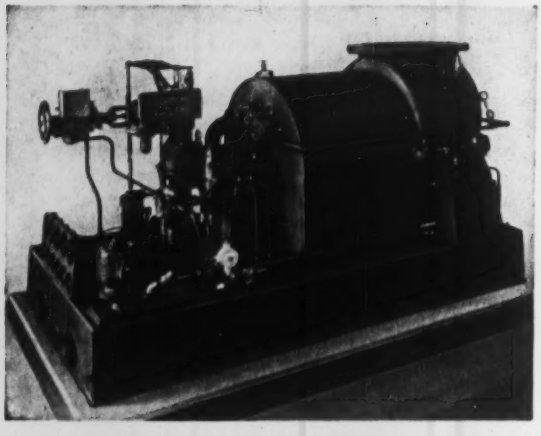


Terry high-speed, high-horsepower turbine on continuous compressor-drive service at National Petro-Chemicals Corporation.

Hedrich-Blessing photo

At National Petro-Chemicals Corporation . . .

Terry high-speed compressor-drive turbines provide continuous 'round-the-clock service



One of the two 5400 hp., 7486 rpm turbines built for the Tuscola plant of National Petro-Chemicals Corporation.

In the fall of 1953, five Terry multistage turbines were placed on day-and-night duty at the Tuscola, Illinois, Plant of National Petro-Chemicals Corporation. They drive high-speed compressors used to compress hydrocarbon gases in the production of ethylene.

The *excellent performance of these initial units later resulted in the installation of two more Terry machines.* These were placed in service some two years later.

In all, the seven turbines total more than 30,000 hp. They range in capacity from 3300 to 5400 hp., and in speed from 7500 to 9700 rpm.

The National Petro-Chemicals installation, and the thousands of other units serving in refineries and chemical plants throughout the world, are testimony to the low maintenance and consistent reliability of Terry turbines. Put Terry to work for you. Write for further information.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

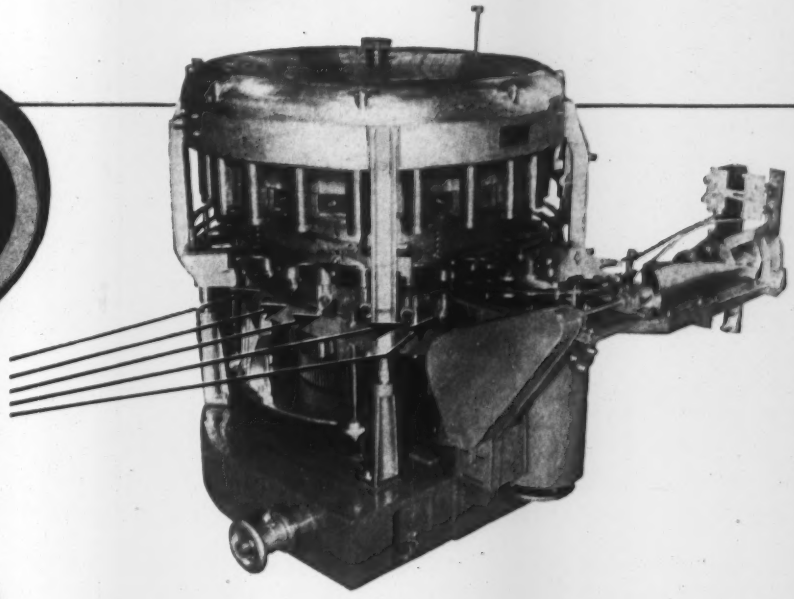
TERRY

TT-1207

HEIM *Unibal* ROD ENDS

contribute to cutting costs through plant modernization.

A dramatic feature of the modernization of the nation's packing plants has been the emphasis on speed as a means of minimizing production costs. The 30-pocket rotary filler for handling liquid or semi-liquid materials, made by the Sprague-Sells division of Food Machinery and Chemical Corporation, as an example of increased speeds, will turn out 650 five-ounce jars per minute. The downward stroke of the piston draws the product into the cylinder, the upstroke forces the material into the container. A closer look at this FMC filler shows a HEIM Unibal Rod End at each of the thirty stations, correcting misalignment where necessary and contributing toward the close accuracy of fill obtained by this machine.



What is your Linkage problem

Perhaps HEIM
can help solve it
. . . or simplify it.

HEIM Unibal Rod Ends consist of a single ball through which the shaft or stud passes, bronze bearing inserts pressed around the ball, and a housing of steel or other specified materials. They correct misalignment in every direction, they reduce friction and lost motion in mechanical linkages, and they cost less than specially machined rod ends.

THE HEIM COMPANY
FAIRFIELD, CONNECTICUT

"A challenge to all of us"...

a statement by ***Robert B. Anderson,*** *Secretary of the Treasury:*

"The ownership by 40 million citizens of over 41 billion dollars in Series E and H Savings Bonds is a striking testimonial of confidence in America's bright future. It means security and opportunity for millions of families —a way to provide for children's education, the building of new homes, or more comfortable retirement.

"America benefits, too, from such widespread savings bonds ownership. This partnership of individual citizens in their government's fiscal operations means better management of the public debt—greater stability for our money—brighter prospects for the years ahead.

"Our country *needs* more savings—in all forms, including U.S. Savings Bonds—to help finance our growing economy; to pay for the plants and tools that mean more and better jobs for our ever-increasing population.

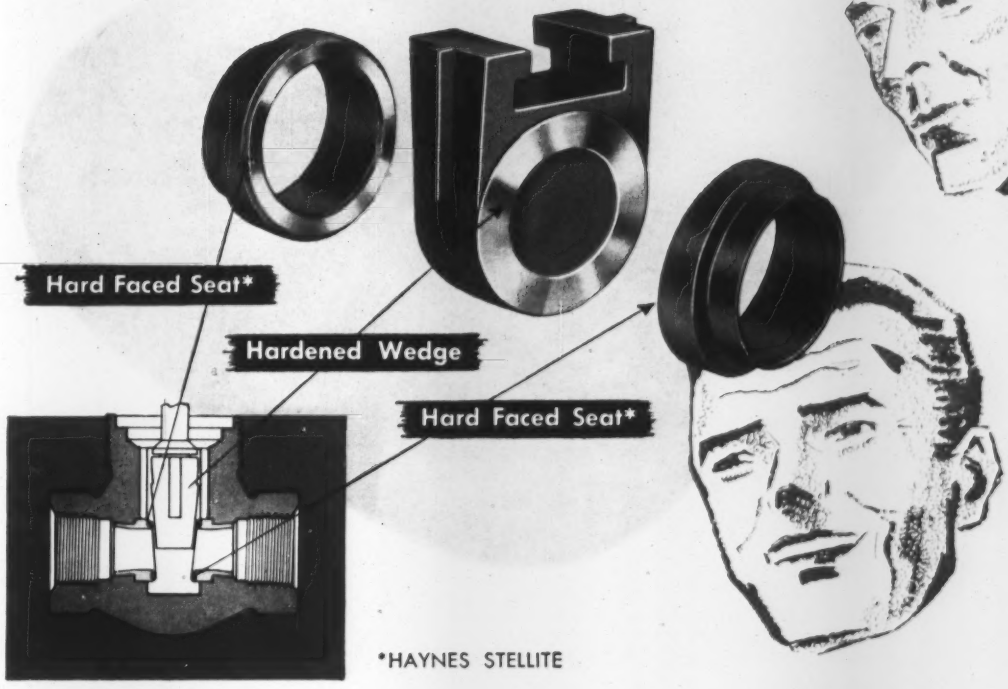
"Meeting this need is a challenge to all of us. Americans everywhere should be encouraged to regularly put aside part of their earnings for future needs. And certainly part of that saving belongs in the now better-than-ever U.S. Savings Bonds."

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING

Tough valve buyers appreciate this kind of...

Toughness



*HAYNES STELLITE

Here's why:—They know that to foil those troublesome valve "termites"—erosion, corrosion, and galling—requires built-in toughness which only seats faced with hard facing alloys AND hardened wedges can provide. Yes, it takes BOTH to do a real job and GP Valves provide both at no extra cost!

Vogt GP Valves feature the toughest and, since they are precision finished, the smoothest seating surfaces obtainable anywhere. That's why they are setting new standards of performance—longer, drop-tight service with minimum, low cost maintenance—in petroleum refineries, chemical plants, power plants and other industries. Available in a complete range of sizes from 1/4" to 2" and rated 800 pounds at 850° F. and 2000 pounds at 100° F.

Advt. No. 5 in a series describing the features of Vogt GP Valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Dept. 24A-F-M.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati.

Vogt

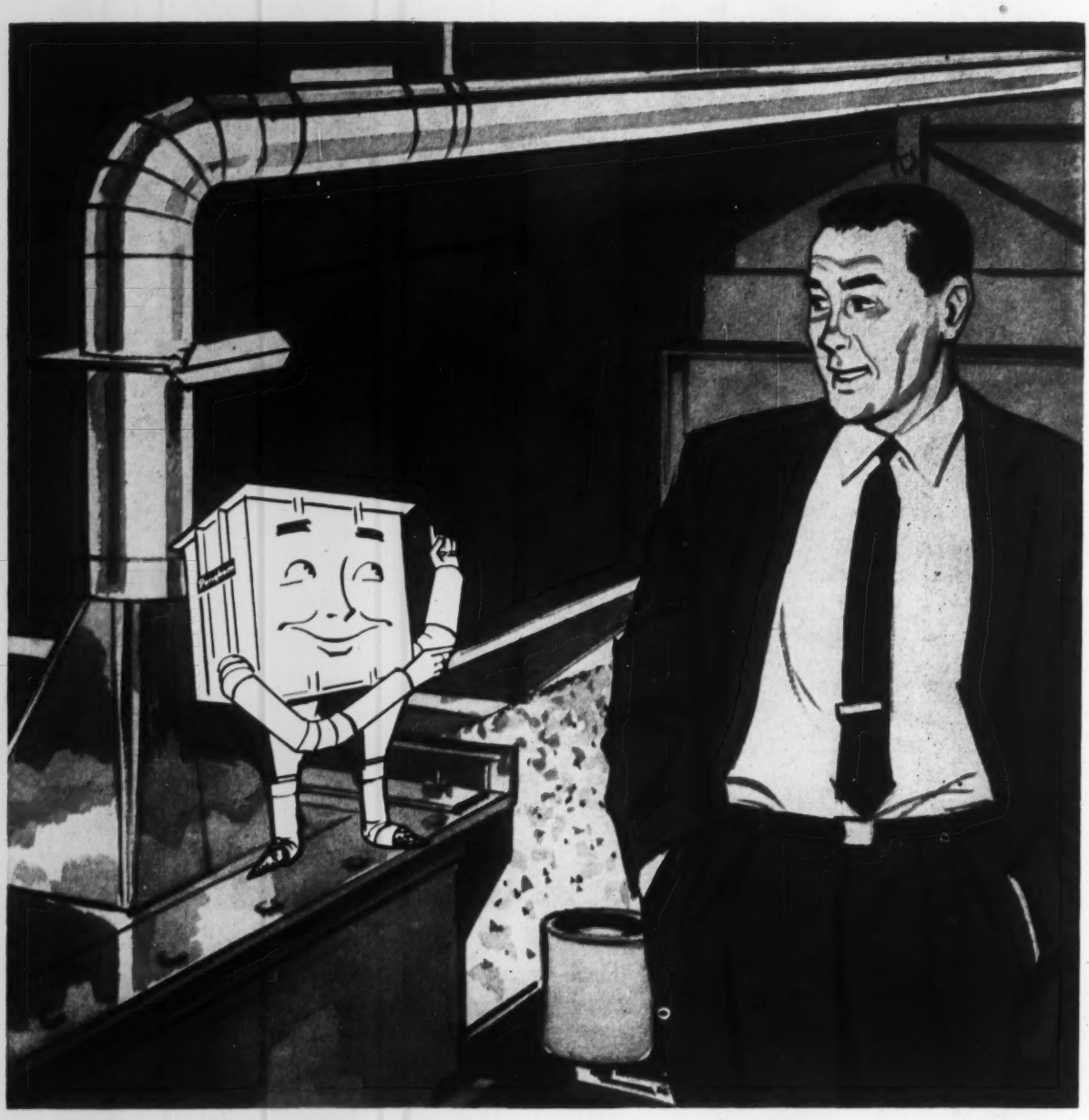
GENERAL PURPOSE GP

Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

HAYNES STELLITE—Trade-mark of Union Carbide Corporation



"What? A 15% increase in production machinery life?"

Yes, Pangborn Dust Control can increase your machinery life up to 15% or more! Pangborn Dust Collectors trap dust controlled at the source to prevent the abrasive wear and tear of uncontrolled dust settling in valuable equipment. Pangborn Dust Control can save you thousands of dollars by substantially lengthening the life expectancy of your machinery.

What's more, Pangborn gives you other benefits of lower housekeeping costs, higher employee efficiency, extra profits from any salvage value and better employee and community relations. And Pangborn offers a complete line of collectors, dry and *wet*, for all jobs.

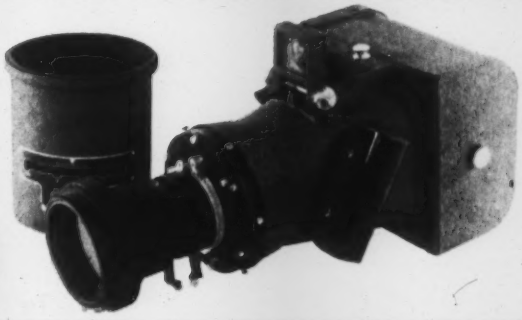
Why not discover how you can profit from Pangborn Dust Control? Write for Bulletin 922 to: PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control & Blast Cleaning Equipment.*

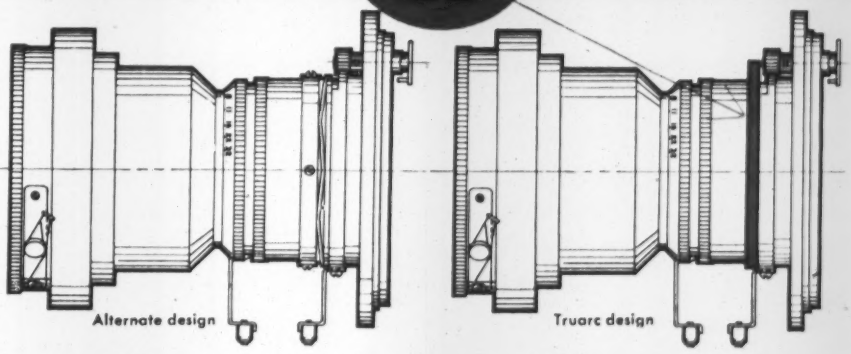
Pangborn CONTROLS DUST

Waldes Truarc Retaining Ring eliminates 7 parts, saves $8.88 in sub-assembly of aerial reconnaissance camera

Gordon Enterprises, No. Hollywood, California, saved the Navy almost 1½ million dollars on 500 cameras. Gordon rebuilt new, efficient "CA" series out of Navy-owned obsolete models. Critical parts are now held together by Waldes Truarc Retaining Rings.

Truarc Rings are trouble-free, will not change position during operation. Accuracy is limited only by groove and ring dimension tolerances. And standardized Truarc Rings are quickly interchangeable in overhaul which now takes only 11 minutes, can be handled by unskilled technicians.





Truarc 5100-287 ring retains shutter speed adjustment mechanism on the Lens Adapter Plate Assembly which mounts and locks the lens and shutter assemblies accurately to camera body. Alternate design required retaining washer, spring, collar and 4 locking screws.

Weight Saving: 7.25 oz.

Assembly Time Saving: . . . . . 6½ min.

DOLLAR SAVINGS:

Material	**$ .93**
Fabrication	**6.88**
Inspection	**1.07**
Total	**$8.88**

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting . . . Waldes Truarc Grooving Tool!

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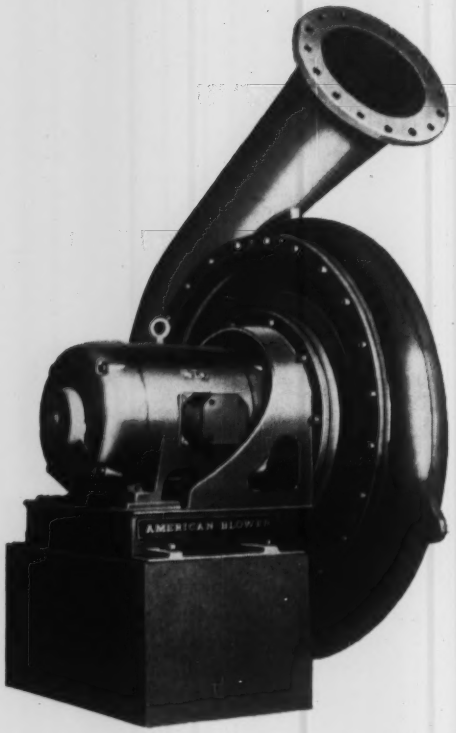
ME 109

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.



An American Blower 250-hp single-stage centrifugal compressor like this one has been in operation as a cupola blower in a foundry for more than 25,000 hours. *Not once has it been down for repairs.*

Dependable performance like this is typical of American Blower Centrifugal Compressors. They're available in single-stage sizes—35 to 2500 hp; pressures from 3/4 to 7 1/2 lb. (psig); volumes from 2500 to 140,000 cfm.

If *you* have a problem involving the application of centrifugal compressors, why not get in touch with our nearest branch for detailed product information?

American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

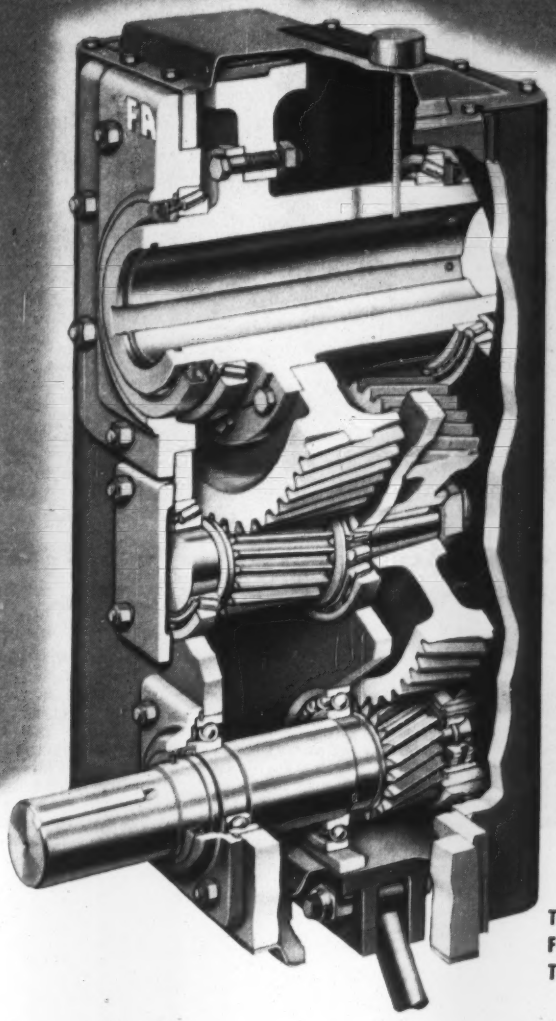
AMERICAN BLOWER

Division of AMERICAN-Standard

New...LARGER...ALL-STEEL!

-the FALK 315J Shaft Mounted Drive

- **for higher horsepower**
- **for lower output speeds**



THE NEW 315J...
FROM 2 HP AT 5 RPM
TO 50 HP AT 359 RPM

Check These Features

New — 3-wall, one-piece housing provides double the ability of cast iron to withstand external impact or shock loads.

New — ratio range—5:1, 14:1 or 25:1. Higher ratio range makes possible lower output speeds...smaller sheaves...standard, rather than slow-speed, motor.

New — ease of maintenance. All revolving elements can be easily replaced in the field, on the jobsite! Inspection covers permit quick inspection of gears and bearings. Dipstick provides quick check on lubricant.

New — longer center distance between shafts allows use of larger sheave on input shaft. Unit may be mounted with input shaft next to driven machine, and with motor mounted directly under driven shaft.

PROMPT DELIVERY

Standard units are available for off-the-shelf shipment from factory, warehouse or distributor stock.

LET US HELP YOU

Your Falk Representative or Authorized Falk Distributor will gladly review your applications and offer suggested selections—without obligation.

Write for Bulletin 7100

The new Falk 315J also gives you these famous Falk advantages—

- Falk extra-depth, extra-capacity gear teeth—plus the extra efficiency (98½% per gear mesh) of helical gears for maximum power utilization.
- Through-hollow shaft design for easy installation, with internal groove to permit use of bearing puller when dismounting unit. Hollow shaft also permits use of unit on through-shaft applications.
- Tie rod fastened to steel housing by steel bracket with bolt in double shear. Shock load on tie rod will not damage housing.

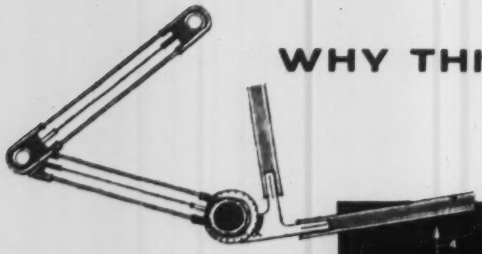
THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

Representatives and Distributors in Most Principal Cities

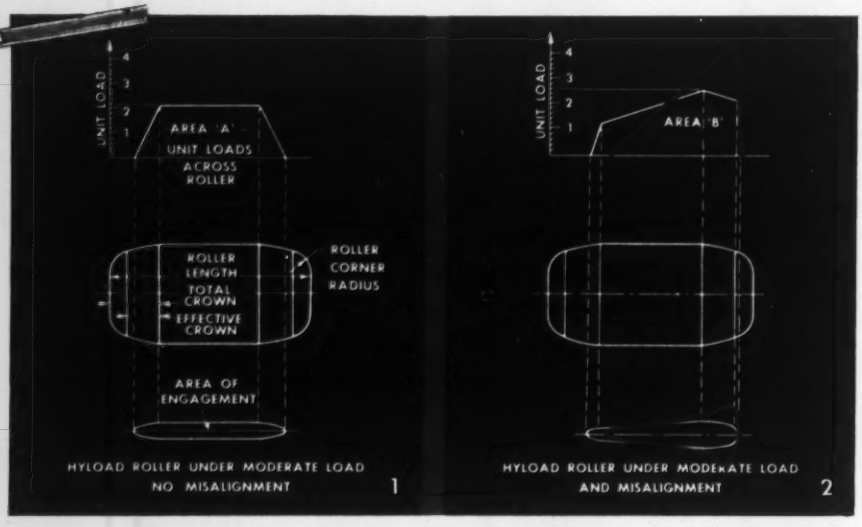
Manufacturers of Quality Gear Drives and Flexible Shaft Couplings

FALK

...a good name in industry



WHY THINGS RUN SMOOTHER WHEN YOU SPECIFY HYATTS

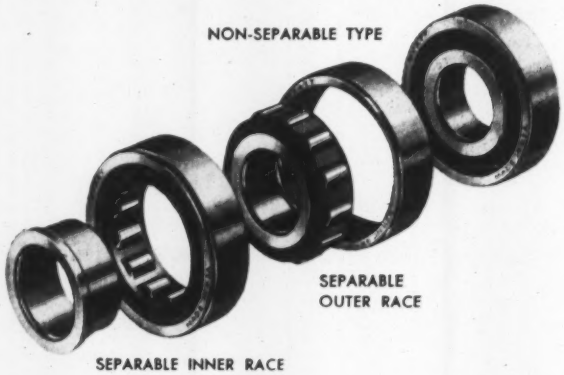


HY-LOAD ROLLER CROWNING MINIMIZES EFFECTS OF MISALIGNMENT—LENGTHENS BEARING LIFE

In any roller bearing, the design and quality of the rollers themselves vitally affect the performance of the entire bearing. The distribution of the load across the roller's full area of contact must be carefully controlled. End-loading and conditions of misalignment can seriously reduce the life of a roller bearing. How HYATT minimizes these effects is detailed at the right.

You will find full selection and application data in HYATT Catalog 150, or call your nearest HYATT Sales Engineer. Hyatt Bearings Division, General Motors Corporation, Harrison, N.J., Pittsburgh, Detroit, Chicago and Oakland, California

The unit load on any roller is distributed axially in a uniform manner except at the ends where crowning has been provided. Figure 1 shows how the unit load drops off to zero at the ends of the area of contact. The summation of unit loads represented by area "A" is the total roller load. This same load under conditions of misalignment (Figure 2) must result in an area "B" equal to area "A"; but the maximum unit load is considerably greater and the misaligned bearing will therefore have a shorter life. However, if the same total load is applied to an uncrowned roller in a misaligned bearing, as shown in red, a much higher maximum unit load (area "C") results, and would reduce the life of the bearing. This demonstrates why HYATT Hy-Load Series Bearings with roller crowning run smoother and longer even under conditions of misalignment.



THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

GM GENERAL MOTORS

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

How **DENISON** hydraulic power works for **LOGEMANN BROTHERS CO.**

Putting more squeeze in presses

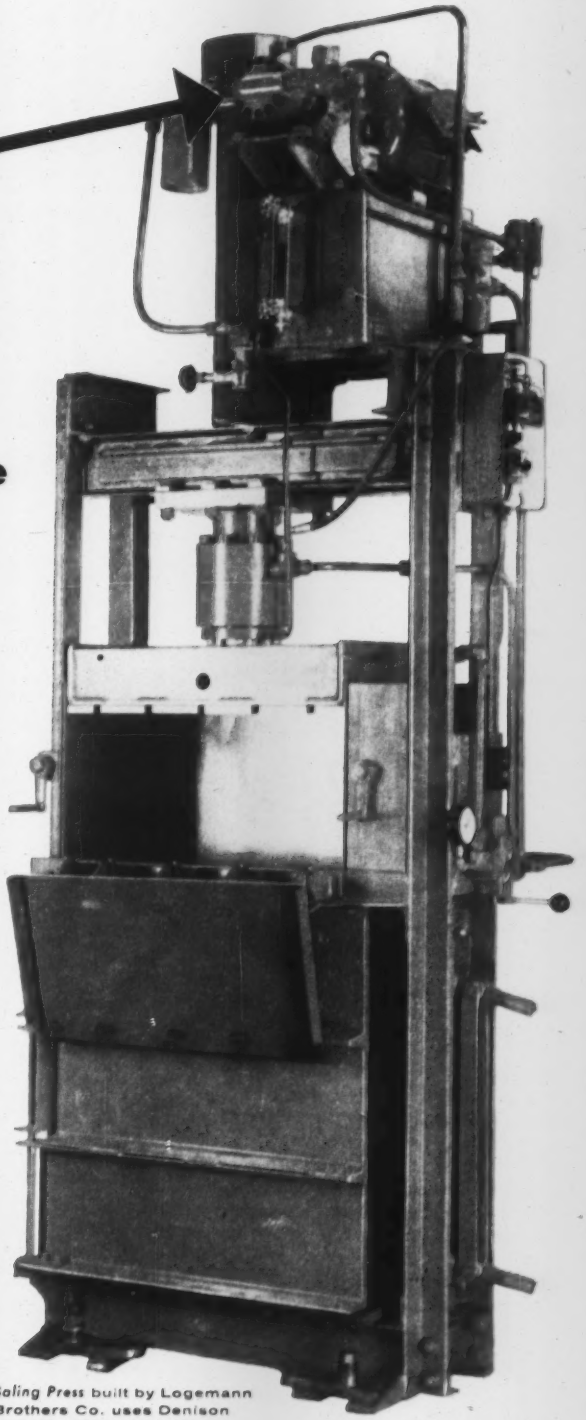
...another application for Denison hydraulic power

Here's how a leading manufacturer of baling presses assures peak performance for his product . . . combines it with dependability for long, continuous service.

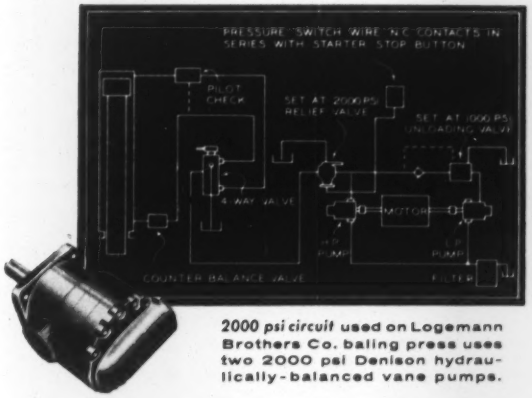
Power and speed of operation are achieved by the use of two 2000 psi Denison TMC balanced-vane hydraulic pumps. One Denison pump is set for 1000 psi for fast ram approach. The second pump is set for 2000 psi to provide necessary pressure for the power stroke.

By using identical 2000 psi pumps, maintenance is simplified and pump life greatly increased.

Endless design problems can be solved by using Denison hydraulic equipment on systems up to 5000 psi. Your Denison representative (who is an experienced hydraulic specialist) will gladly show you how. Write us. Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.



Baling Press built by Logemann Brothers Co. uses Denison pumps and valves for 2000 psi hydraulic system.



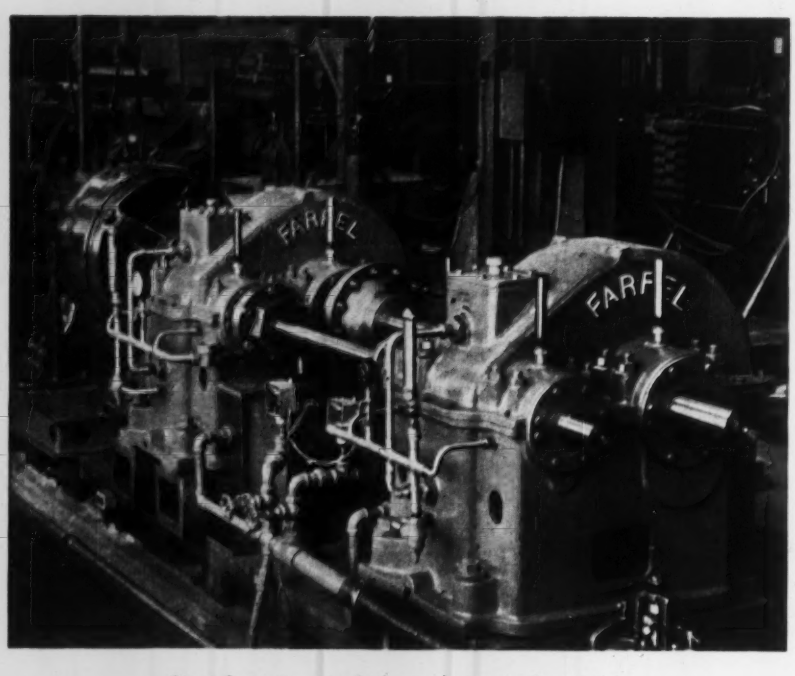
2000 psi circuit used on Logemann Brothers Co. baling press uses two 2000 psi Denison hydraulically-balanced vane pumps.

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

Farrel® speed reducers get a physical checkup



Setup for testing two high-speed units to observe performance under various conditions of load and speed.

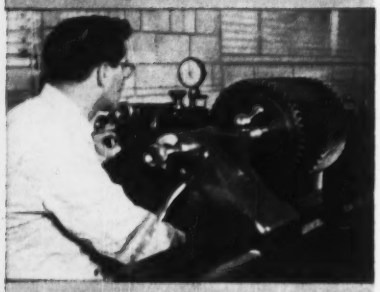
Recently, the Farrel line of speed reducers was re-engineered, rerated and expanded to increase the horsepower in relation to size, and to extend the advantages of the units to additional applications.

A vital phase of this program was the physical research involved. The many improvements and consistent high quality found in the new line are a result of exhaustive experimentation which was carried on in connection with every aspect of speed reducer manufacture. Pictured here, are some of the facilities and equipment employed in the Farrel laboratory and shops for checking and testing gear units.

Toughness... stamina... long life ... these are the qualities of Farrel units which stem from the sound design, the high-grade materials, and the step-by-step precision that go into their making. Investigate the broad new line of Farrel speed reducers. For further details, send for a copy of Bulletin 450.

▲ Involute tooth checker for measuring accuracy of profile.

▼ Checking accuracy of tooth spacing.



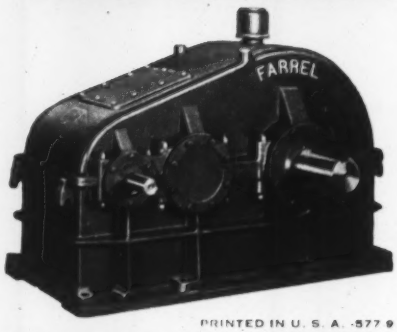
▲ Checking helix angle or lead.

▼ Accuracy and uniformity of tooth thickness is checked with Farrel comparator.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Boston, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Fayetteville (N. C.), Los Angeles, Salt Lake City, Tulsa, Houston
European Office: Piazza della Republica 32, Milano, Italy

Farrel-Birmingham®



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*Snap-Tite

QUICK-CONNECT

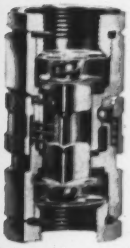
QUICK-DISCONNECT COUPLINGS

in larger sizes

immediate delivery

FROM FACTORY STOCKS

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

See the Snap-Tite representative in your city or write for Bulletin 240.

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

*Snap-Tite, INC.

UNION CITY 4, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

HAVE YOU RESERVED YOUR COPY OF THE 1958 MECHANICAL CATALOG?

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You'll find MECHANICAL CATALOG easy to use because it is edited exclusively for you, the mechanical engineer, *by* mechanical engineers.

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This new edition of MECHANICAL CATALOG (the 47th) is as up-to-date as exhaustive checking with both manufacturers and engineers can make it. We think you'll find it one of ASME's most valuable services and one of your most useful reference sources.

If you have not already requested your copy, fill out and mail the coupon promptly.

The American Society of Mechanical Engineers

29 West 39th Street, New York 18, N. Y.

Mr. C. E. Davies, Secretary

Please send me my copy of the 1958 Mechanical Catalog
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Title _____

Company _____

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Principal Product or Service _____

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Kellogg's Fabricating Abilities Keep Pace

Culminating many months of intensive work with Philadelphia Electric Company, including the testing and evaluation of numerous alloys, M. W. Kellogg is now fabricating the 2,400 ft. of main steam piping, which it will also install, for Eddystone Station Unit No. 1.

Piping is made of Type 316 Stainless, designed for use at 5,000 psi-1,200 F. at the turbine throttle. Calculated minimum wall equals 2.344 in. from Boiler to Sulzer Stop Valves (8 leads), 2.188 in. from Sulzer Stop Valves to Mixing Header (8 leads), and 2.656 in. from Mixing Header to Turbine (4 leads).

Kellogg's ability to handle the exacting task of bending, welding, heat treating, and testing such huge amounts of heavy-walled pipe to close schedules is a major reason for the company's long-standing reputation in the industry.

The M. W. Kellogg Company welcomes the opportunity to discuss its complete power piping design, fabrication, and installation facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.

M. W. Kellogg has developed many welding techniques for the fabrication of high alloy steam piping, including K-Weld*. With this unique technique of arc welding, the pipe interior is under controlled inert gas pressure —assuring complete root bead penetration and a highly uniform internal contour without the use of backing rings.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.

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POWER PIPING—THE VITAL LINK

• Trademark of The M. W. Kellogg Company

The funny hole in Mr. Cooper's building

MANY a New Yorker shook his head, and not a few snickered, when they saw the "hole" in Peter Cooper's new building.

But to the benign gentleman with the ruff of graying whiskers it was all so simple: Some day someone would perfect the passenger elevator.

The mere fact that there wasn't one in 1853 would mean little to a man who, with his own hands, had built and driven the first American locomotive. Whose money, and faith, were to help see the Atlantic Cable through all its disasters to final success. And who would "scheme out" a Panama Canal plan fourteen years before DeLesseps.

But Peter Cooper's belief in the future ran in a vein far deeper than simply the material. For his "building with a hole" was Cooper Union, the first privately-endowed tuition-free college in America. A place where young men and women of any race, faith, or political opinion could enjoy the education which he, himself, had been denied. Peter Cooper's dearest dream—which has continued to grow dynamically for nearly a century and today enriches America with thousands of creative thinkers, artists, and engineers.

There is plenty of Peter Cooper's confidence and foresight alive among Americans today. It is behind the wisdom with which more than 40,000,000 of us are making one of the soundest investments of our lives—in United States Savings Bonds. Through our banks and the Payroll Savings Plan where we work, we own and hold more than $41,000,000,000 worth of Series E and H Bonds. With our rate of interest—and the safety of our principal—guaranteed by the greatest nation on earth. You're welcome to share in this security. Why not begin today?

Now Savings Bonds are better than ever! Every Series E Bond bought since February 1, 1957, pays 3¼% interest when held to maturity. It earns higher interest in the early years than ever before, and matures in only 8 years and 11 months. Hold your *old* E Bonds, too. They earn more as they get older.

PART OF EVERY AMERICAN'S SAVINGS BELONGS IN U. S. SAVINGS BONDS

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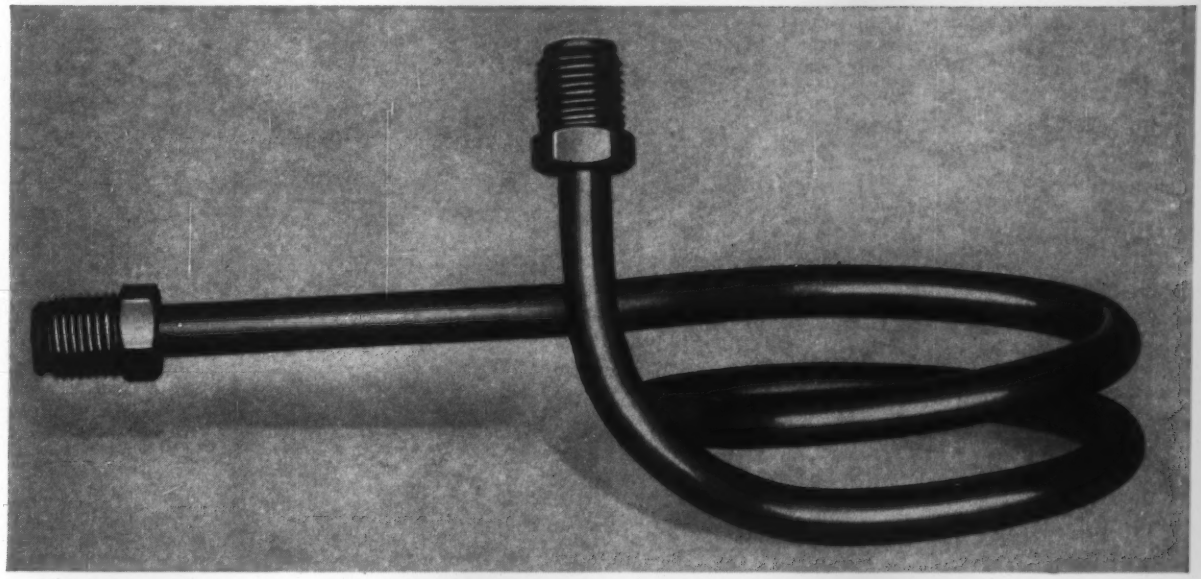
Space limits, low tolerances on brake tube call for Bundyweld's greater ductility



Double loop in this junction tube lets it meet rigid space requirements; also absorbs vibrations set up by differences in the movements of power cylinder and junction block. Tight tolerances are held on both the loop and the position of the ends, which are double-flared with fittings attached.

PROBLEM: Produce a junction tube to fit the restricted space between the power cylinder and junction block in a power-brake system . . . yet hold the low tolerances required for high-speed assembly.

SOLUTION: Take advantage of Bundyweld's greater ductility to design a *dual-purpose* junction tube — as Bundy® engineers helped one customer do. Not only does the tube meet limited-space and low-tolerance requirements . . . but its specially designed loop absorbs vibrations set up by differences in the movements of power cylinder and junction block.

Here again, Bundyweld® was chosen because its greater ductility permits holding tricky tolerances in mass production. And Bundyweld's high bursting strength assures long-lived *leakproof* performance in any high-pressure hydraulic system . . . one reason it has become the safety standard of the automotive industry. *95% of today's cars use Bundyweld, in an average of 20 applications each.*

Bundy's skilled fabricators mass-produce the junction tube—coil the tubing, attach the fittings and then double-flare the tubing ends. Finished parts are delivered on schedule . . . clean and ready to use.

If *you* want to save time, hold down costs on tubing design or fabrication, check first with Bundy. Call, write, or wire us today.

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

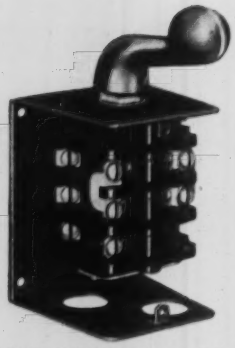
Bundyweld starts as a single strip of copper-coated steel. Then it's
. . . continuously rolled twice around laterally into a tube of uniform thickness and passed
through a furnace. Copper coating fuses with steel. Result . . .
SIZES UP TO ¾ O.D.
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

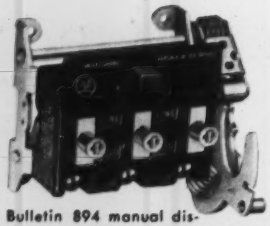
THERE IS NO REAL SUBSTITUTE FOR

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP



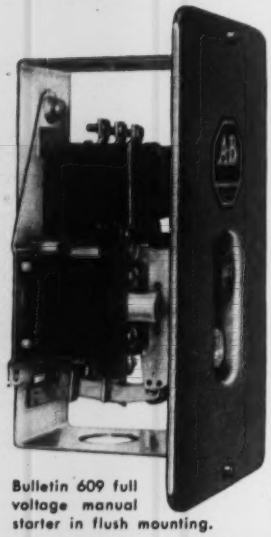
Bulletin 806 pilot drum switch—10 ampere size—with cover removed to show terminals.



Bulletin 894 manual disconnect switch in base of grinder.

Bulletin 800T oiltight selector switch for Hand-Off-Auto control.

Bulletin 800T transformer type pilot light—550 volts, maximum.



Bulletin 609 full voltage manual starter in flush mounting.

Wesson Poweramic Tool Grinder with A-B manual motor controls for 3 motors.

Close-up of control panel of Wesson Poweramic Tool Grinder with flush type motor controls.

Streamline your motorized machines with Allen-Bradley flush type controls

By using flush type control units, the Wesson design engineer not only succeeded in grouping the controls for the three motors within easy reach of the operator, but in streamlining this Poweramic tool grinder, he gave it added sales appeal.

The flush mounted manual starters fit into recesses just above the flush mounted drum switch. The manual disconnect switch near the bottom of the machine base controls the power supply of the entire machine.

Flush type control equipment provides a wonderful opportunity for designing compact, good-looking machines. Follow this modern trend—and increase your sales. Let us send you our latest Handy Catalog giving full data on the Allen-Bradley line. Write, today.

Allen-Bradley Co.
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In Canada:
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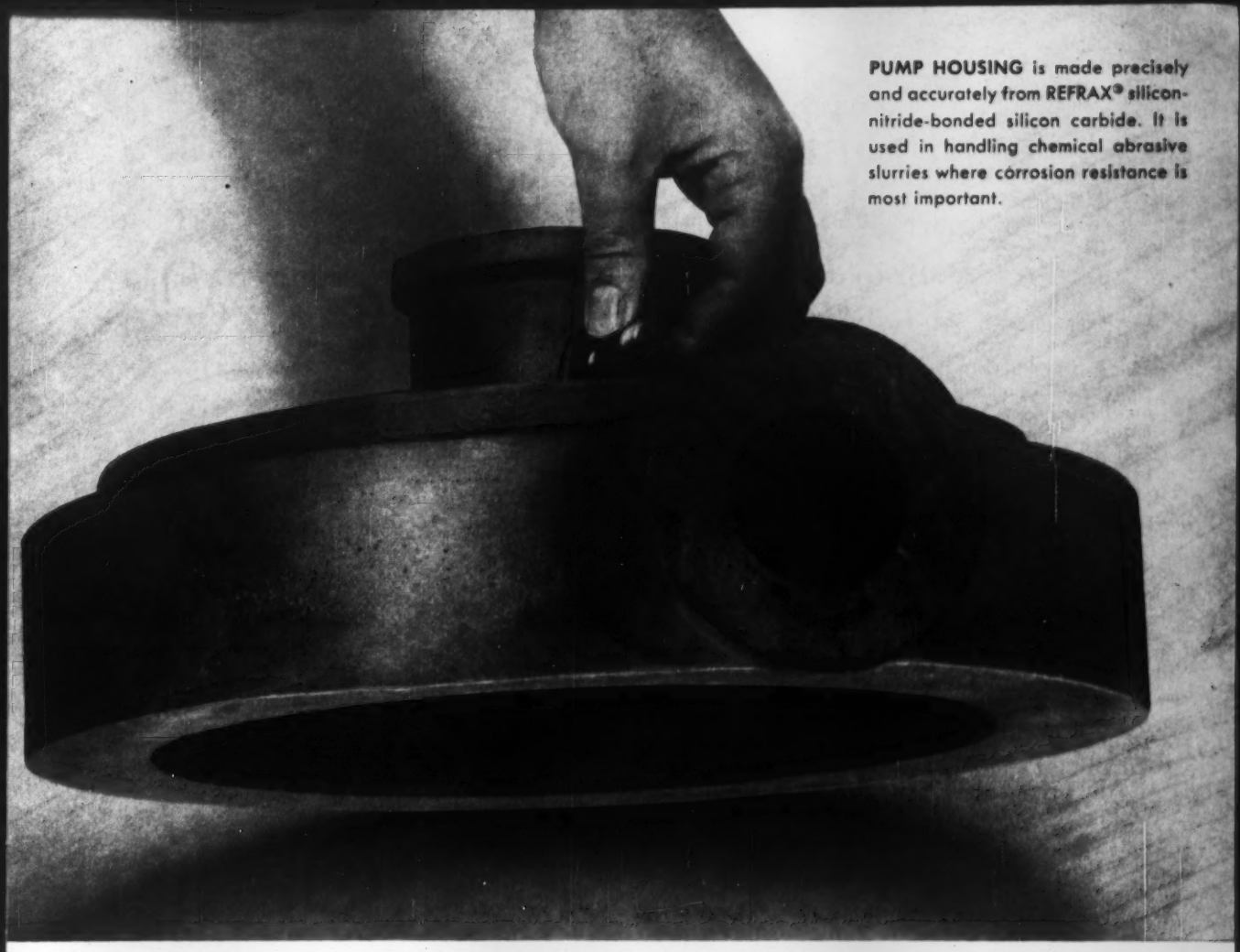
ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY



PUMP HOUSING is made precisely and accurately from REFRAX® silicon-nitride-bonded silicon carbide. It is used in handling chemical abrasive slurries where corrosion resistance is most important.

Refractories . . . to surpass **metals**

What material combines *all* the following properties? Corrosion resistance so that it is not wet by molten aluminum, and resists attack by most acids; abrasion resistance that prevents wear by both high velocity particles and sliding heavy masses; the ability to withstand temperatures to 3000° F; hot strength so high that at 2450° F its modulus of rupture is 5600 psi?

What material *combines* all these properties? Obviously not a metal, not even a cermet. It is one of Carborundum's special refractories — REFRAX® silicon-nitride-bonded silicon carbide. This material can be precisely formed to tolerances of ±0.005 in./in. with external and internal threads. Finish resembles that of a cast iron part.

Your high temperature problem, no matter how complex it may be, can almost certainly be solved with one of the scores of super refractories by Carborundum. For assistance, write for these three booklets:

CARBORUNDUM
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WRITE FOR FREE ENGINEERING AND APPLICATION DATA

Complete data on REFRAX® high temperature materials is contained in these three booklets: Refractories Magazine issue on REFRAX®; reprint of article in Product Engineering, Feb. '57 entitled "Nitride-bonded silicon-carbide bridges gap between metals and ceramics"; and Engineering Data Bulletin on REFRAX®.

Refractories Division, The Carborundum Company, Perth Amboy, N. J., Dept. I-107

One of a series.

Some Things to Think About Steam Traps

. . . in order to get high operating efficiency and a minimum of maintenance

The gentleman who invented the wheel had a basic idea and so far no one has come up with anything better for the purpose.

If you'll pardon us for a little overemphasis on the significance of steam traps, we'd like to liken one of them to the wheel.

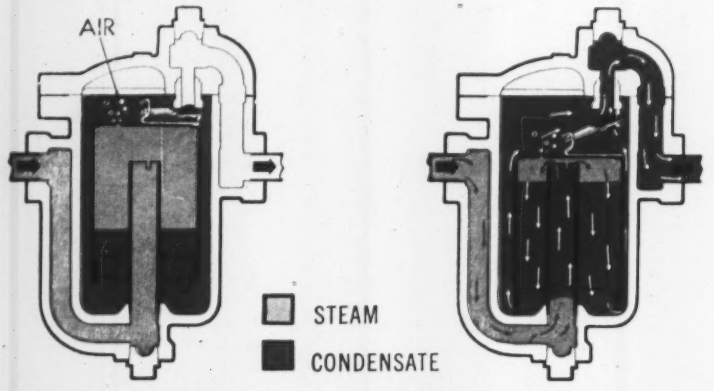
In 1911, when the first Armstrong inverted bucket steam trap model was announced to the world, or at least that part of the world that modest advertising and sales budgets would cover, it was not received with equal enthusiasm by all (especially old-style trap makers). But, like the wheel, it managed to find its way into general use. And, nothing better has ever turned up for the purpose of draining condensate. As a matter of fact, the Armstrong trap has been very widely copied. Today, there are more inverted bucket traps draining process equipment than any other kind. Of these, there are more Armstrongs.

If this sounds like the boasting of a proud parent, give consideration to some fundamental requirements not met by all traps:

1. ***A steam trap should not leak steam.*** Some traps do, you know, because of the nature of their operating principle. No steam ever gets to the Armstrong trap orifice. The valve is always water sealed.

2. ***A steam trap should vent "air" as fast as it accumulates***—otherwise temperatures are reduced and corrosion is a problem. The Armstrong trap handles air very nicely. The vent in the bucket permits air to accumulate in the top of the trap, from where it is discharged when the trap opens. For extreme conditions like draining paper machine dryers, some jacketed kettles and certain other units, the vent is sized larger for the job. And, for handling big volumes of air during warm-up, a bucket with an auxiliary thermic vent really speeds up heating.

3. ***A steam trap should discharge condensate at steam temperature*** if you want to get maximum efficiency from the unit drained. And most people certainly do. If you have to wait for the condensate to cool, it's almost impossible to maintain maximum temperatures and prevent air build-up. You guessed it—the Armstrong trap opens for water, without dependence on temperature.



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket, vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

4. ***A steam trap should be suitable for any return system.*** The Armstrong trap works just the same whether discharging to atmosphere, back pressure or vacuum. It has been conclusively proved that flash steam resulting from use of a bucket trap does not cause a problem in vacuum return systems. The flash condenses rapidly. It's the leaky traps that cause the headaches.

5. ***A steam trap should not be a "prima donna".*** Some kinds of traps take an awful lot of care and coddling. The Armstrong trap is a rough and ready type with a hardened chrome steel constitution (valve and seat, to be exact). It cleans itself of ordinary dirt and scale without choking up. Its 18-8 stainless parts stave off rust and corrosion. It resists wire-drawing and wear remarkably well. In fact, it stays on the job longer with less attention than any trap ever produced. Unless you live in Siberia, you can probably find a user around the corner who will tell you so from experience.

6. ***A trap should not be an "orphan".*** With Armstrong traps you can *always* get prompt service and parts from nearby Factory Representatives and stocking distributors as well as from the factory.

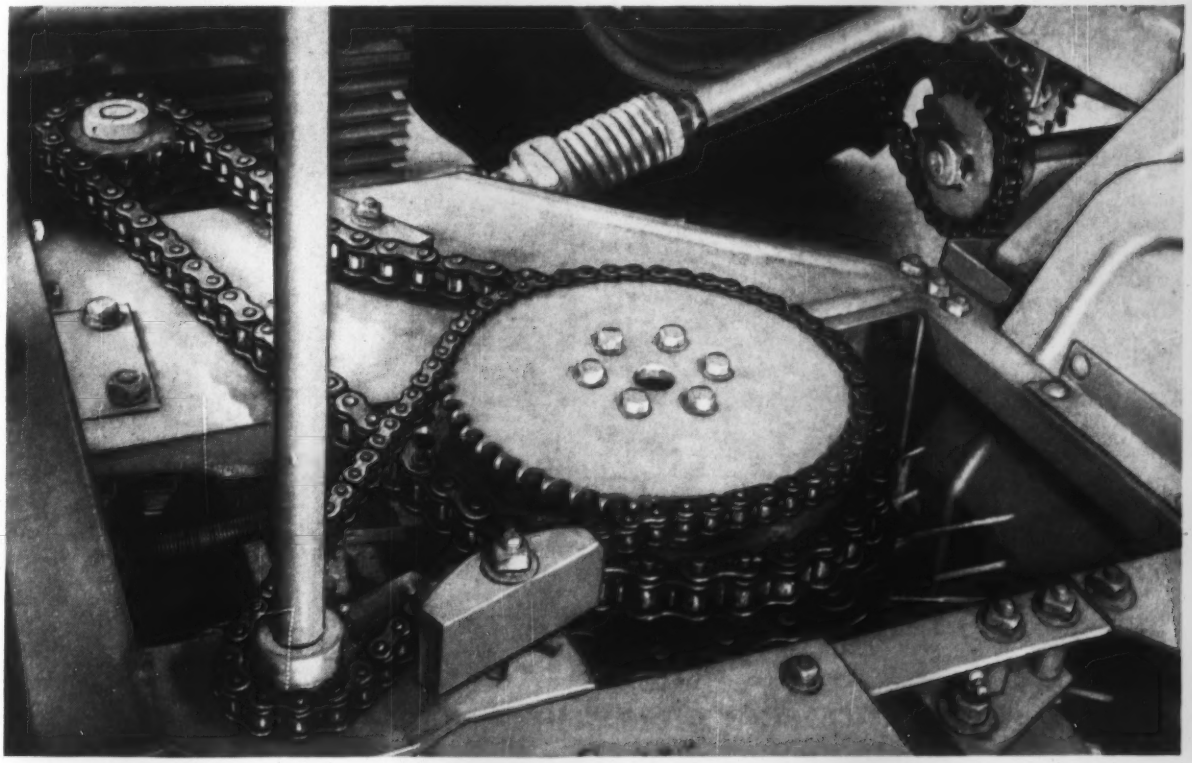
7. ***A trap should have a guarantee.*** The Armstrong trap is unconditionally guaranteed to give you *complete satisfaction* (as to doing its job, that is). If it doesn't, you can get your money back.

If you'd like to buy some of these excellent steam traps, call your local Armstrong Representative or write **Armstrong Machine Works, 8945 Maple St., Three Rivers, Michigan.**

ASK FOR the 44-page Steam Trap Book, free on request without obligation.

ARMSTRONG STEAM TRAPS

Satisfaction and performance are assured when coordinated power transfer is entrusted to DIAMOND roller chains



Adopting and specifying DIAMOND roller chains has become the established custom of experienced discriminating engineers and machinery builders the country over.

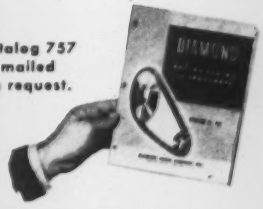
DIAMOND CHAIN COMPANY, Inc.,

Dept. 413, 402 Kentucky Ave., Indianapolis 7, Ind.

Offices and Distributors in All Principal Cities

Refer to the classified section of your telephone directory under the heading CHAINS or CHAINS-ROLLER.

Catalog 757 mailed on request.

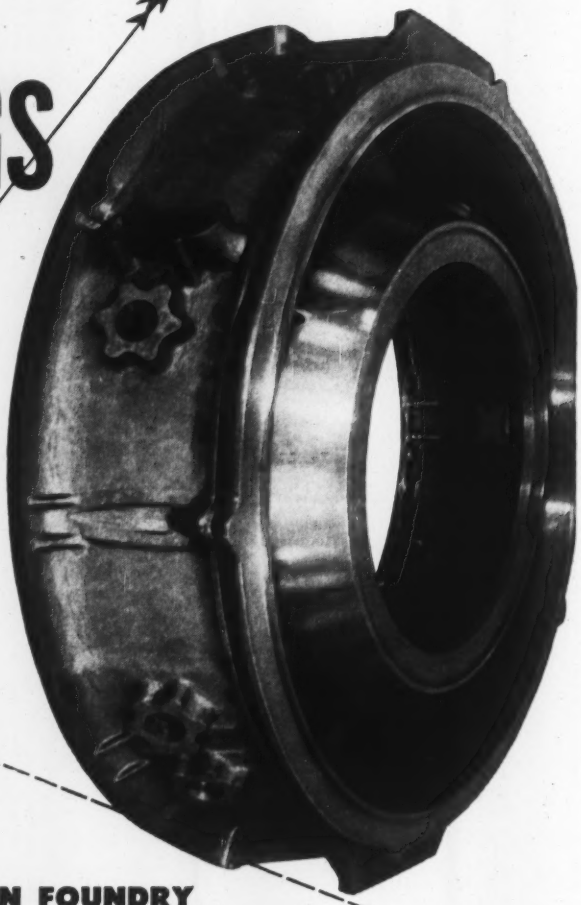


DIAMOND ROLLER CHAINS

AIRCRAFT QUALITY

ALLOY CASTINGS

...for the special requirements of your industry



METALS PROCESSING DIVISION FOUNDRY
handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is ±.030 over 36″ diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron... by sand, centrifugal, ceramic or shell processes.

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FORGET IT!

Flexon® *PACKLESS*
EXPANSION COMPENSATOR

Install it . . . and walk away from it once and for all! Flexon Model H Expansion Compensator is the modern way to take up expansion and motion in pipes up to 3", because it's *packless.* No maintenance required—ever. It's there to stay, for the life of the building.

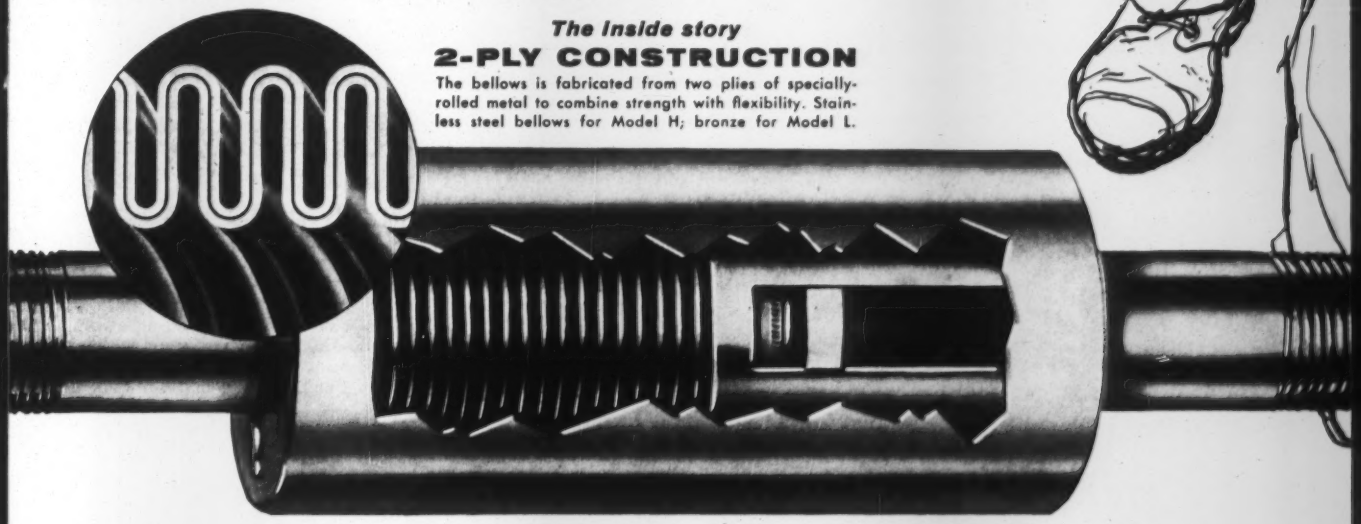
You get delivery when you need it, because Flexon Model H Expansion Compensators are available from stock. *And here's a bonus!* They cost much less per inch of stroke than any other method of absorbing pipe expansion. Up to 1¾" total movement in all sizes. Working pressures up to 150 p.s.i. for ¾" and 1" sizes; up to 100 p.s.i. for larger sizes.

Write for facts about Flexon Expansion Compensators, design and cost data, and the name of your Flexon distributor.

The inside story

2-PLY CONSTRUCTION

The bellows is fabricated from two plies of specially-rolled metal to combine strength with flexibility. Stainless steel bellows for Model H; bronze for Model L.



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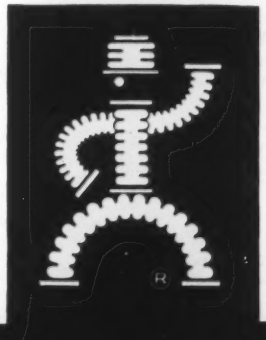

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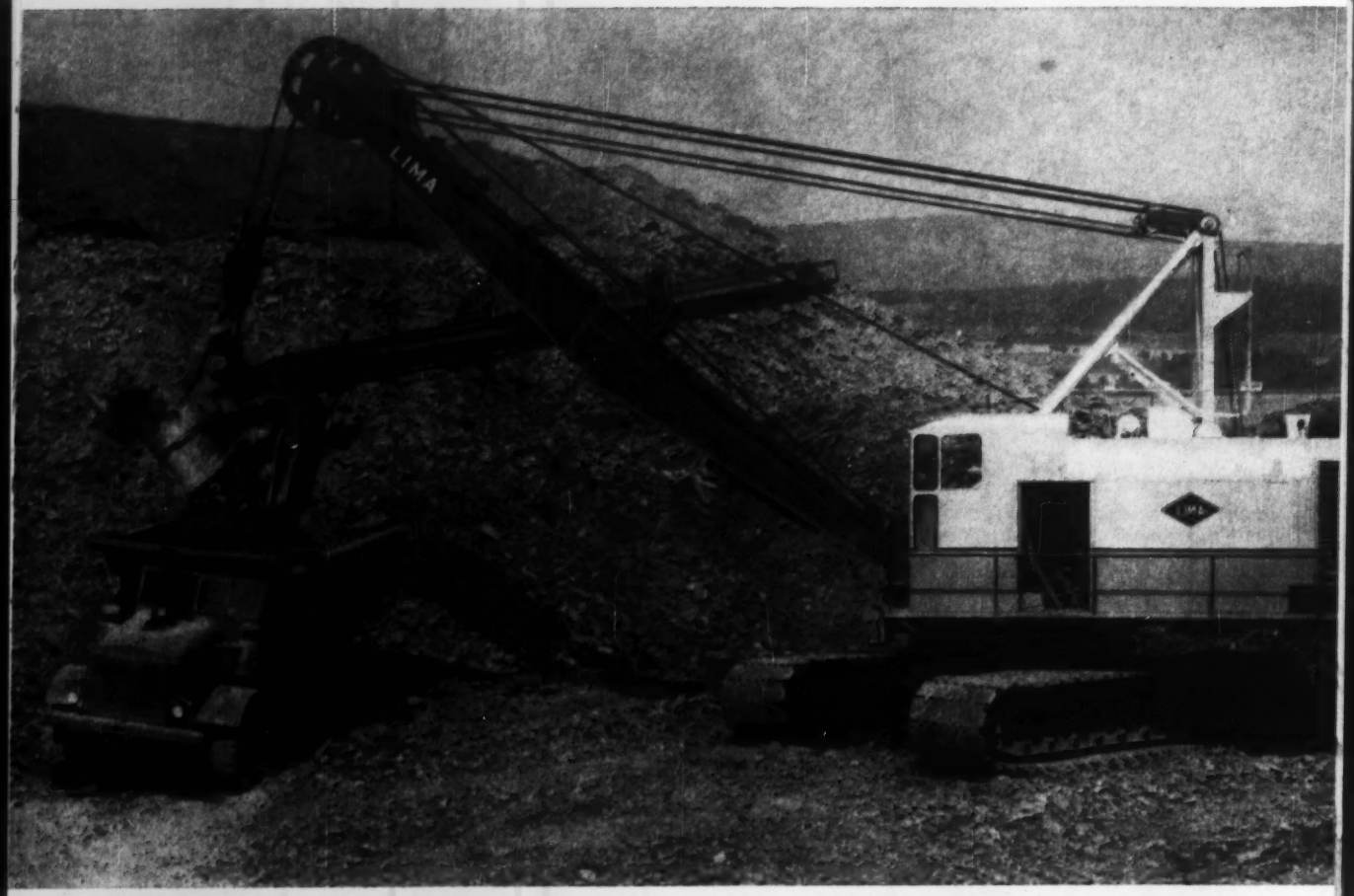
EXPANSION JOINT DIVISION • 1305 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EXPANSION JOINTS · METAL HOSE · NON-METALLIC HOSE · BELLOWS · AIRCRAFT COMPONENTS

Specifically developed for equipment



To obtain the strongest possible dipper handle

The dipper stick of this 6-cu.-yd. Lima power shovel is made of USS TRI-TEN Steel, hot-pierced and drawn into a tube, with 18" O.D. and 1½"-thick wall. Says the manufacturer, "We adopted USS TRI-TEN Steel to obtain the strongest possible dipper handle with the minimum of weight. A dipper handle is subjected to bending strain, as well as heavy impact loading, yet weight must be kept as low as possible since excess weight means the reduction of payload. Previously used ordinary steels did not stand up to hard usage."

20 cubic yards at a bite

This big-capacity Bucyrus Erie dragline bucket can scoop up 20 cu. yds. of overburden at one bite. It has to stand pounding far beyond the ordinary. That is why it was built with USS TRI-TEN Steel which ensures rugged strength and high resistance to impact and shock at any atmospheric temperature. The good welding and working properties of USS TRI-TEN Steel, even in the heavy thicknesses required here, greatly facilitate fabrication.

UNITED STATES STEEL
USS
HIGH STRENGTH STEELS
1933 1957
24 YEARS OF PERFORMANCE

that has to take it on the chin...

USS TRI-TEN High Strength Steel

THE PUNISHING ABUSE that today's heavy-duty earth moving and mining equipment has to withstand puts a high premium on durability.

Unless power shovels, draglines, trucks, bulldozers, scrapers and mechanized mining units have the rugged stamina to stay on the job under all conditions, day after day, the many thousands of dollars invested in them can easily become a losing proposition. Breakdowns, repairs and maintenance must be kept to a minimum. That's why USS TRI-TEN High-Strength Low-Alloy Steel is being increasingly used in the vital parts of such equipment.

USS TRI-TEN Steel has special properties that recommend it for applications where maximum ruggedness, toughness, strength and endurance—*combined with minimum weight*—are of prime importance.

An outstanding advantage of this steel, and one that will be appreciated by every equipment user who has been plagued by part breakage during severe cold spells, is USS TRI-TEN Steel's ability to withstand impact shock at sub-zero temperatures.

Not only is USS TRI-TEN Steel very tough but it is very strong as well. Its yield point of 50,000 psi min.* is 1½ times that of structural carbon steel and is combined with a tensile strength of 70,000 psi min. in thicknesses of ¾" and under, with moderately lower values as thicknesses increase up to 4". TRI-TEN Steel, too, has greater resistance to abrasion than structural carbon steel. It has twice the resistance to atmospheric corrosion. Its fatigue resistance is 50% higher. And its cost is low.

In addition, USS TRI-TEN Steel has good weldability and excellent workability, important factors that help to cut costs in fabrication and repair work. Our 174-page "Design Manual for High Strength Steels" will guide you in applying USS TRI-TEN Steel most efficiently and economically. Write for your free copy—on your company letterhead, giving your title or department—to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

**Still higher strength can be obtained with USS "T-1" Steel—a constructional alloy steel that offers a yield strength of 90,000 psi min. and tensile strength of 105,000 psi min. combined with weldability and tremendous toughness.*

To absorb the grief of heavy duty

Used in the Minnesota iron ore mines, the entire interior surface of this 24-cu.-yd. Heil dump truck body is of USS TRI-TEN Steel. The floor is 1"-thick plate, sides and front are ⅜" plate. Experience on the Iron Range has proved that TRI-TEN Steel provides the strength and toughness necessary to withstand severe impact and loading shocks even in the coldest weather. And it does this better and more economically than many more expensive grades.

United States Steel Corporation, Pittsburgh · American Steel & Wire Division, Cleveland · Columbia-Geneva Steel Division, San Francisco
National Tube Division, Pittsburgh · Tennessee Coal & Iron Division, Fairfield, Ala. · United States Steel Supply Division, Warehouse Distributors
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USS HIGH STRENGTH STEELS

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UNITED STATES STEEL

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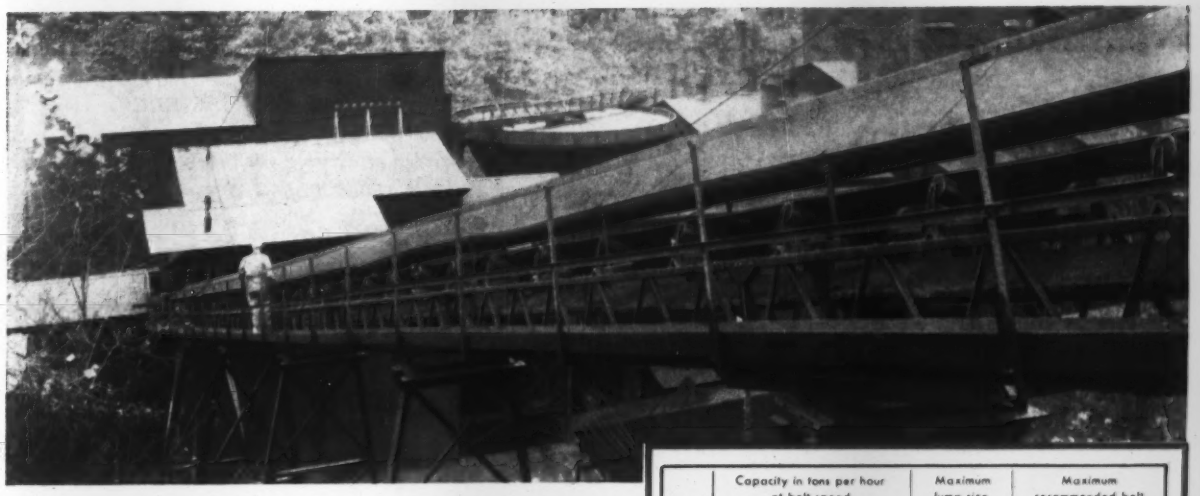
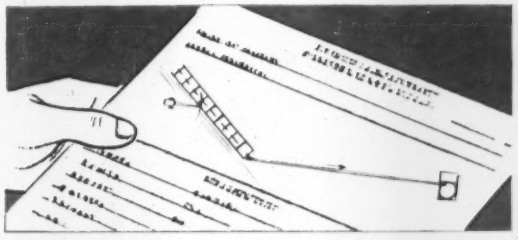


For lower costs down the line
make your belt conveyors

PRE-BILT by LINK-BELT

Belt width, inches	Capacity in tons per hour at belt speed of 100 FPM			Maximum lump size, inches		Maximum recommended belt speed, FPM	
	Weight of material, lbs. per cu.ft.			Sized	Unsized	Half maximum size lumps	Maximum size lumps
	50	75	100				
18	27	40.5	54	3	5	400	300
24	50	75.0	100	4½	8	500	400
30	81	121.5	162	7	10	600	450
36	117	176.0	235	8	14	650	500

EASY SELECTION. Your Link-Belt engineer will help you choose the best combination from a wide selection of PRE-BILT sectional belt conveyor components.



PROMPT ESTIMATES. From standardized data, an "on-the-site" quotation can be prepared covering the components for your needs.

SPEEDY DELIVERY. Standardized parts are shipped from the nearest of 8 plants. One-source availability eliminates the delay of coordinating purchases from several suppliers.

FAST INSTALLATION. Due to simple construction and shop-assembled components, you can do your own erecting. Link-Belt also furnishes complete erection service and supervision.

Link-Belt PRE-BILT sectional belt conveyors combine operating efficiency and economy to give you years of dependable, profitable operation.

For full information on these durable conveyors up to 36 in. wide—with drives up to 40 hp, 24 and 42-inch truss depths—contact your nearby Link-Belt office, or send for Book 2579.

LINK-BELT

BELT CONVEYORS

14.7102

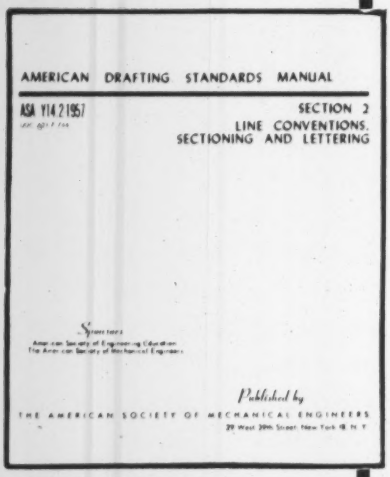
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

American Drafting Standards Manual

Several years ago, the Committee on Standards for Drawings and Drafting Practice undertook the monumental task of revising and expanding the 1946 Standard. With National Standardization as the goal, the Committee examined all available references, including standards of many companies and the government services; circulated drafts of the proposed standards among a large number of colleges and industries for suggestions and criticisms; and made every possible effort to develop guides suited to the needs of the industries. Described below are four of the seventeen sections of the new Manual that have just been published. As the other Sections are released, notices of their availability will be published.

SIZE and FORMAT
Section 1
(Y14.1–1957) $1.00

This Section provides basic information for the standardization of the drawing formats that will be acceptable for widespread application in American industries.


AMERICAN DRAFTING STANDARDS MANUAL

ASA Y14.2 1957

SECTION 2
LINE CONVENTIONS, SECTIONING AND LETTERING

Published by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

LINE CONVENTIONS, SECTIONING AND LETTERING
Section 2
(Y14.2–1957) $1.50

Recommendations and illustrations for line conventions cover the width and character of lines, applications of line symbols, hidden line technique, and special applications of extension lines. Rules and illustrations applying to sectional views include section lining on detail drawings and on assembly drawings, direction and spacing of general purpose section lines, and the cutting plane. On lettering, sizes for the different purposes and styles recommended are illustrated.

PICTORIAL DRAWING—Section 4
(Y14.4–1957) $1.50

In this Section are defined and illustrated the various kinds of pictorial drawings, the correct methods of using them, and the proper nomenclature.

DIMENSIONING AND NOTES—Section 5
Y14.5–1957 $2.00

This new section represents a general revision and broadening of the treatment given in Sections 5, 6 and 7 of the 1946 Standard. It deals with all aspects of the dimensioning problems faced by those preparing drawings and covers subjects which were given little consideration in older drawing practice standards such as positional tolerancing, tolerances of form, and their relationship. The hundred-odd sketches which supplement the text replace those in the 1946 document.

20% Discount to ASME Members

The American Society of Mechanical Engineers

29 West 39th St. New York, N. Y.

IF YOU ARE RESPONSIBLE for the creation of new products and the redesign of existing ones, there is a wealth of information that you should know about in the

Proceedings of the 1957 DESIGN ENGINEERING CONFERENCE

Sponsored by the Machine Design Division of the ASME and held concurrently with the Second Design Engineering Show in New York, this Conference brought together top authorities in several fields of product design for the purpose of reviewing recent advances in the field of general design; reporting new developments in design of gearing, cams, machine tools, and for easier machining; discussing new materials and their uses; and proved information on how various organizations develop new designs.

CONTENTS

PROCEDURES IN DEVELOPING NEW DESIGNS
NEW DEVELOPMENTS IN DESIGN AND APPLICATION OF GEARING
NEW DEVELOPMENTS IN DESIGN AND APPLICATION OF CAMS
METALLIC MATERIALS
CERAMICS AND REFRACTORY MATERIALS
SELECTING MOTORS WITH NEW NEMA FRAME SIZES
STATIC SWITCHING DEVICES
DESIGNING FOR EASIER MACHINING, HANDLING AND ASSEMBLY
HOPPER FEEDING
PLASTICS AND RUBBERS
COATINGS AND FINISHES
NUMERICAL CONTROL FOR MACHINERY
DESIGNING MACHINE TOOLS FOR AUTOMATIC CONTROLS

Published, September 1957 $4.00

Proceedings of the FIRST (1956) DESIGN ENGINEERING CONFERENCE

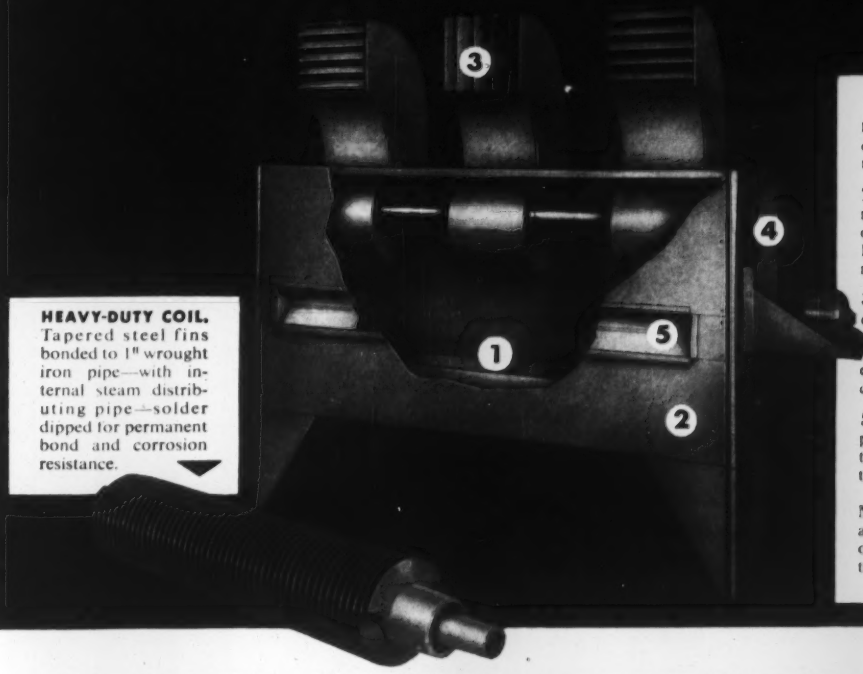
In this book, nine authorities in various aspects of design engineering discuss the need for attracting men to the field, training them and making provisions for rewarding them for outstanding achievements, such as, recognition for, and legal rights to inventions. The technical topics discuss new cost reduction as an important element in design and selection of engineering materials, and the effect of the trend toward miniaturization.

Published, 1956 $3.50

Combination Price for First and Second Proceedings—$6.50.

Fact:

Rugged Westinghouse Industrial Heaters available in 24 Sizes . . . 8 Coil Selections . . . 150 Ratings from 100,000 to 2,500,000 BTU/hr . . . 2,000 to 25,000 CFM each



HEAVY-DUTY COIL. Tapered steel fins bonded to 1" wrought iron pipe—with internal steam distributing pipe—solder dipped for permanent bond and corrosion resistance.

1. Proven, Westinghouse-manufactured, extended surface heating coils good for continuous operation up to 200 psig.

2. Die-formed casings with rounded corners eliminate accidents and dirt catching pockets. Front and back panels easily removable.

3. Multiple louvered outlets for efficient distribution of heated air.

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5. Face and by-pass dampers permit continuous air circulation to maintain uniform temperatures.

NOTE: Louver type mixing box accessory permits introduction of fresh air for make-up and ventilation, with or without filters.

Solve your space heating problems with Westinghouse-Sturtevant Industrial Heaters. Eliminate cold, drafty conditions caused by excessive cold infiltration through leakage or exhaust.

Two Types With Wide Applications:

GENERAL PURPOSE HEATER . . . For manufacturing areas, warehouses, garages, commercial buildings—with standard non-ferrous heating coils.

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The compact packaged engineering of every Westinghouse-Sturtevant Industrial Heater provides units for mounting on floor, walls, or suspended from ceilings. In short, they can be placed where they will do the most good, and can be relocated to meet any change in plant layout.

Every unit is backed with a Westinghouse exclusive—*one warranty*. Only Westinghouse makes all principal components—Fans, Heating Coils, and Motors. You can get unit engineering and single equipment responsibility.

MORE FACTS? To find out how to solve your particular heating problem, call your Westinghouse-Sturtevant Sales Engineer . . . he is the "Man With The Facts" on heating, air handling, and electronic air cleaning . . . or fill in coupon below.

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COMPANY .....

CITY ..... STATE .....

frame of reference

The chart below is a simplified representation of 11 different staff member fields at Sandia Corporation. You might call it an occupational frame of reference, within which are located the many activities involved in our work—design and development of nuclear weapons for the Atomic Energy Commission. In each of the 11 fields, challenging positions are available for qualified engineers and scientists at all degree and experience levels.

	ENGINEERING	PHYSICS	MATHEMATICS
Applied Research			
Weapon Systems Engineering			
Component Development			
Electronic Development			
Handling Equipment Design			
Standards Engineering			
Quality Assurance and Surveillance			
Environmental Testing			
Field Testing			
Manufacturing Relations Engineering			
Military Liaison and Field Engineering			

There are many other things you'll want to know about Sandia Corporation. You'll be interested in our extremely liberal employee benefits. You'll want to know about the advantages of working and living in Albuquerque, famous for its healthful year-round climate and recreational attractions. You'll want information on schools, homes, and cultural facilities. And you'll want to know more about our work, and our background as a research and development laboratory. Our illustrated brochure answers these questions, and many others. For your copy, please write to Staff Employment Section 553A.

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IT GIVES STEPLESS, CONTINUOUS BALANCING!

Advance features to improve control of temperature, pressure, flow . . .

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2. No dry cell—no standardizing
3. No high-speed moving parts
4. No slidewire or galvanometer
5. *Stepless*, continuous balancing
6. Adaptable to narrow spans

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In addition to ceaseless experimental work, this up-to-the-minute engineering laboratory, with the aid of the world's largest test chamber (wind tunnel), tests Aerovent units under simulated operating conditions. Typical resistances which may be encountered in actual operation are applied to each unit, to assure satisfactory performance and economy in every industrial application.

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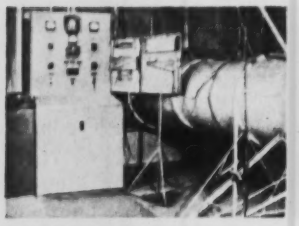

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for observing and recording operating characteristics of fans being tested in chamber shown at top.

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for confirming of wind tunnel tests and performance data, and conducting endurance test programs.

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Certified Ratings

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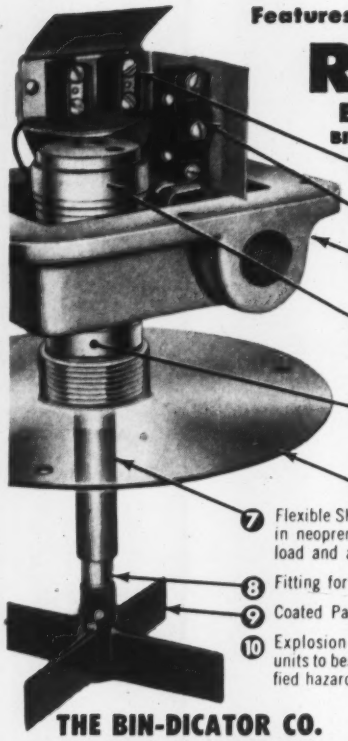

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3. Dust-tight gray iron housing; std. or exp. proof.
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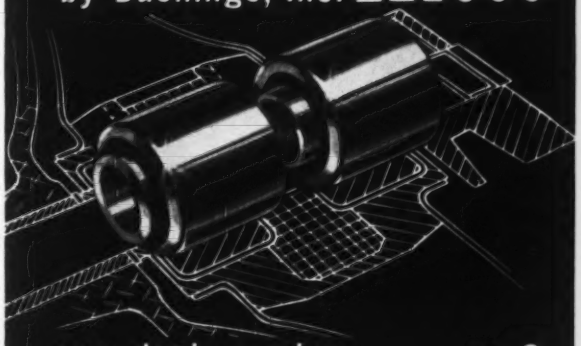

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VIBRO-LEVELER MOUNTS dampen vibration, permit precision leveling of machines.

SILENT-LIGN PILLOW BLOCKS for shaft mounting. Has all Flexible Bearing features.

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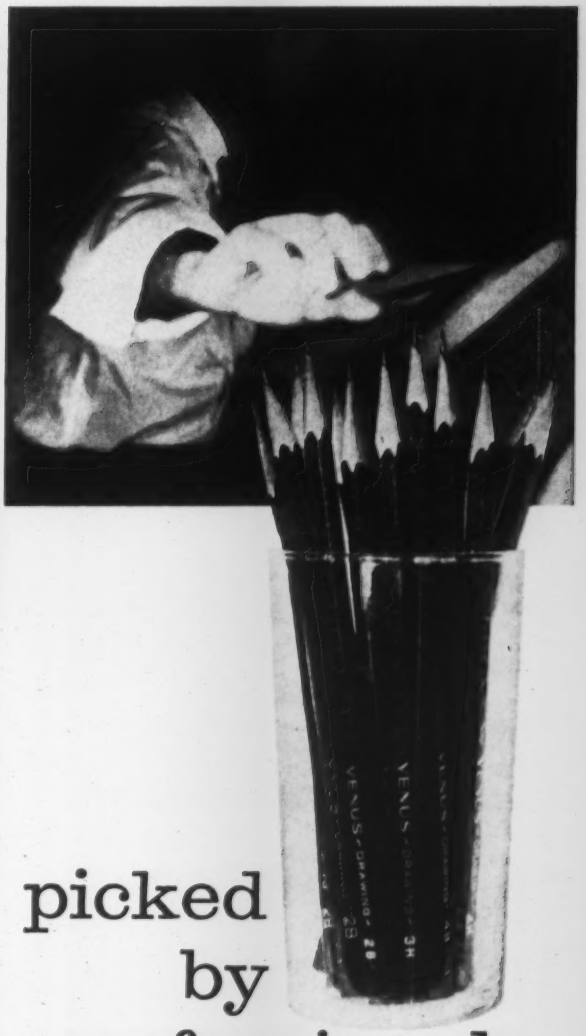

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Entire assembly designed for prompt and easy installation. Now available at new low cost. Capacities 5, 10, 15 tons.

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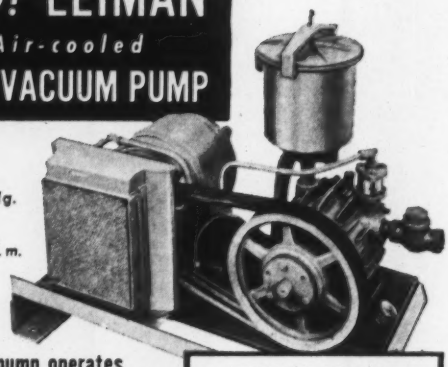
Air-cooled
HIGH VACUUM PUMP



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CAPACITY
15 to 40.8 c. f. m.

Air-Cooled pump operates 24 hours a day at 140°F.

This air-cooled Leiman Rotary Positive High Vacuum Pump gives you greater capacity in a smaller pump—a compact pump unit that can be placed anywhere. It incorporates the Leiman 2-wing rotary pump, with steel blades, cast iron cylinders and patented automatic wing adjuster which assures leak-proof seal for years and years. Put one on test.

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Other Leiman Air Pumps:
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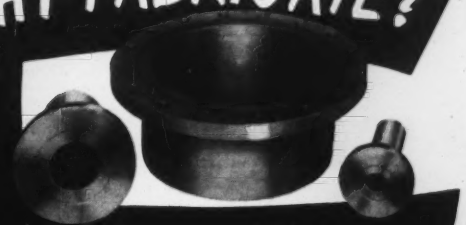

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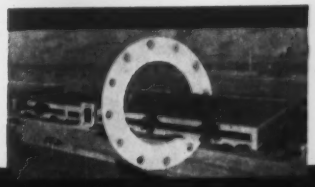

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ME-10

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Our detailed proposal will be sent without obligation. Send name, bore, stroke and speed of machine.

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Where performance is the measure

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increase rating to
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Now rated at 80 hp. per cylinder at 1200 rpm. the Fairbanks-Morse Model 38F 5¼ Diesel is available in sizes from four to ten cylinders.

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Turbine Engineers

BSME or BSAE with experience in mechanical and aerodynamic design . . . to carry out aerodynamic studies for the design and development of specific turbine units or parts . . . and to undertake the analysis and solution of mechanical design problems encountered in high speed, high temperature usage.

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Small groups working in a professional atmosphere with in-plant opportunities to climb the ladder . . . this is yours as an engineer in our Jet Engine Department. Your ideas, as well as your experience, are important to us. Send us your resume or phone us collect:

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Aggressive Research and Development activities have made Edward Valves, Inc., a leader in the steel valve industry.
We have expanded our Research facilities to maintain this position.
Openings are for Engineers (mechanical, stress, flow, materials, metallurgists) interested in design and development of valves for high pressure, high temperature service and nuclear power applications. Replies are confidential.

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Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

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If you are now earning in the neighborhood of $15,000, and are ready to move into the next bracket, send a resume in complete confidence to **H. M. Overley, P. O. Box 7258, Phila 1, Pa.**

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Progressive manufacturer of pumping, water softening and agricultural spraying equipment has openings in its Product Development Division. Excellent opportunity for men in 25–35 age group to grow with an expanding and diversified program. Located in pleasant town of 16,000 northeastern Ohio. Experience in hydraulic or farm equipment with manufacturing background desirable. Must be capable of following project thru design, model building, testing and production release. Excellent drafting, model shop and testing facilities are part of division setup.

Liberal benefits program including insurance coverage, retirement and vacation policy.

All inquiries will be considered promptly and in strict confidence.

Please submit resume of personal data, education, experience and earnings in your reply to:

Mr. Frank Rucker
Personnel Manager
F. E. Myers & Bro. Co.
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WANTED:

A graduate engineer with some experience to become Technical Secretary of a non-profit scientific research organization in the Metals field who can in a few years assume complete managerial charge of the work. Metallurgical and Welding Research experience desirable. Please give full particulars, age, accomplishments and starting salary desired.

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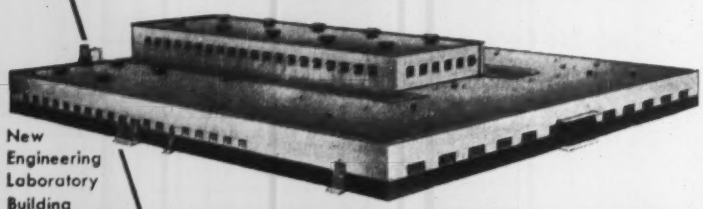

New Engineering Laboratory Building

A LEADER IN THE FIELD OF NUCLEAR PROPULSION

MECHANICAL ENGINEERS

The Reactor Development Division offers a challenge to Mechanical Engineers ready to accept responsibility in designing and developing complete atomic power plants. Sixty-seven per cent of our requirements for technical college graduates call for Mechanical Engineers.

The nation's largest privately owned nuclear engineering and development center is now in operation on a 535 acre site midway between New York and Boston. Ours is a dedicated hardworking professional team. Many of us are taking work under a Company Sponsored program for advanced degrees at the nearby Hartford Graduate Center of the Rensselaer Polytechnic Institute.

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Our Engineering Departments are: Core Manufacturing, Development Laboratory, Materials Development, Power Plant, Prototype and Reactor.

NEW POSITIONS FROM BEGINNING TO SUPERVISORY LEVELS

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REACTOR DEVELOPMENT DIVISION
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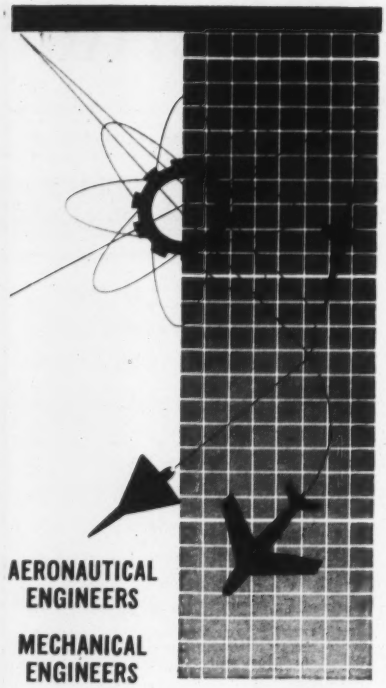
Address .....

City ..... **State** .....

Submit Resume to Frederic A. Wyatt



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Individual advancement aided by Full Tuition Refund Plan for graduate study leading to an M.S. degree, and in-plant courses in nucleonics.

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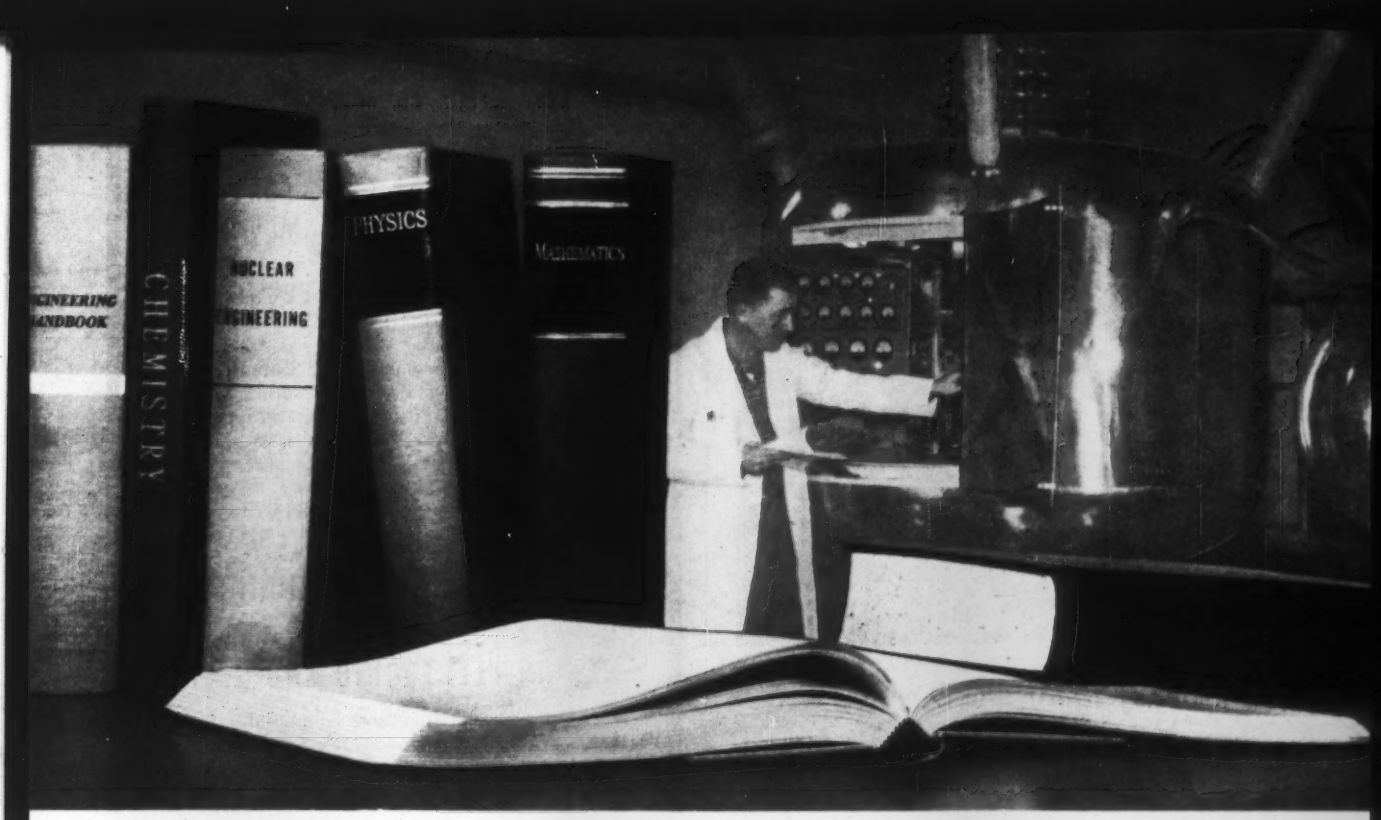

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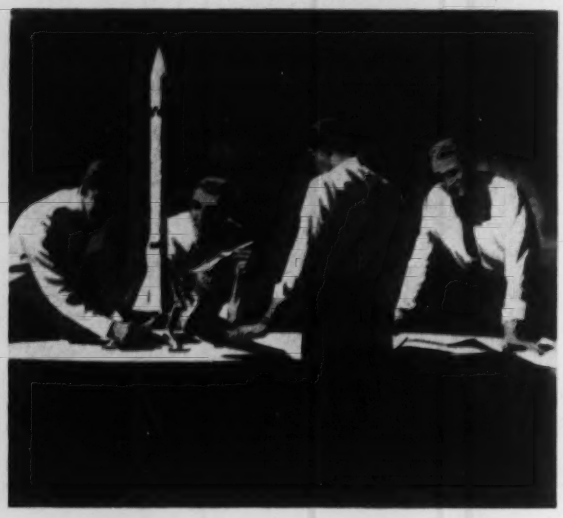
IMPORTANT DEVELOPMENTS AT JPL



Teamwork in Missile Development

The Jet Propulsion Laboratory provides a wide range of research and development activities. Projects include problems in the fields of Electronic, Mechanical, Aeronautical, Chemical and Metallurgical Engineering, Physics and Mathematics.

The fluid character of these activities provides a keen incentive to JPL engineers and scientists. These men are given wide latitude and unusual individual responsibility—at the same time working as a thoroughly integrated team on all aspects of entire missile systems rather than on certain highly specialized missile components.

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A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

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FOR ADVANCED ELECTRONIC SYSTEMS

High level product engineering skills are needed to incorporate new systems concepts into military equipment now under development. The importance of these projects makes it essential to apply the most modern design criteria and to utilize the latest packaging and fabrication techniques. An excellent position awaits the engineer who can contribute advanced techniques to this effort. Openings exist for:

SENIOR MECHANICAL ENGINEERS

and

SENIOR ELECTRONIC ENGINEERS

It is desirable that applicants hold an M.S. Degree and have approximately six years' related experience, some of which should be with microwave equipment.

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The Ramo-Wooldridge Corporation

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To work on heat transfer, thermodynamics and hydrodynamics of atomic reactors and associated components for power generation. Expanding department of well established upstate New York manufacturer provides excellent potential for well-qualified personnel. Company's ability to produce is proven by the Army Package Power Reactor Plant completed on time and now operating routinely.

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Copies of the List are obtainable from

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Publication-Sales Dept.

29 West 39th St., New York 18, N. Y.

Left to right: J. M. Motis, Equipment Installation Group Engineer, G. H. Estabrook, Department Manager of Airframe Propulsion and Internal Systems, and A. R. Schroter, Senior Structures Design Engineer discuss design vehicle nose structure and related equipment.

To engineers with keen interest in STRUCTURAL DESIGN FOR MISSILES

Major programs at Lockheed Missile Systems require a high order of achievement in structural design.

Emphasis is on new ideas, new techniques, new approaches.

A number of positions have been created for engineers to:

- Design missiles structures to an optimum strength-weight ration using newest material and fabrication methods;
- design models required for analysis of aerodynamic, thermodynamic and propulsion data;
- outline and supervise structural tests required to prove the structural integrity of missiles;
- control structural integrity at both test and manufacturing levels.

Assignments are of a most advanced nature. Creativity and the ability to exercise individual initiative are essential to fill positions open on Lockheed's Sunnyvale and Palo Alto Staffs.
Engineers possessing these attributes are invited to write the Research and Development Staff, Sunnyvale 24, California.

Lockheed

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A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

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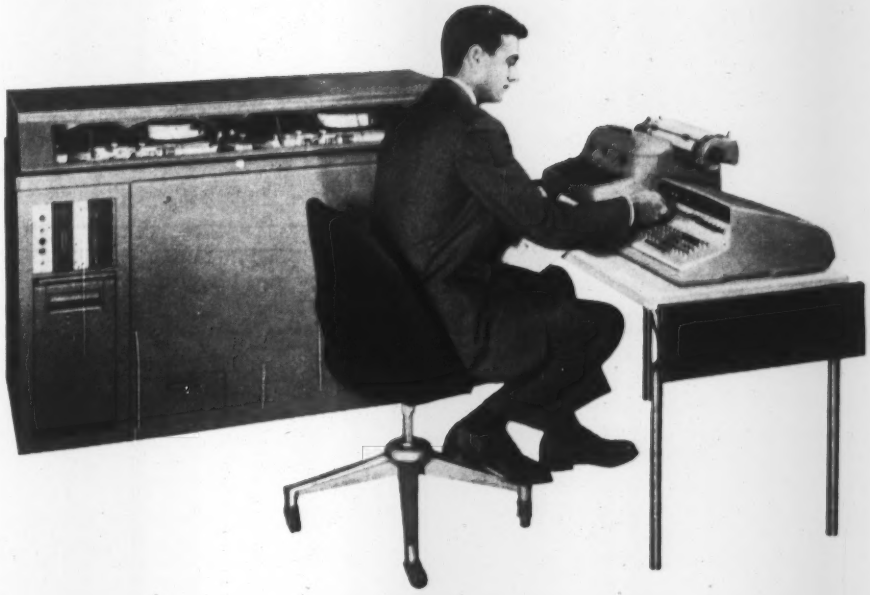

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For the engineer and scientist, with a minimum of instruction, the compact new IBM 610 Auto-Point Computer provides large-scale electronic computer facilities at desk-side.

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RMI REACTION MOTORS, INC.

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Recent Engineering graduates, preferably M.E., for approximately one year inside sales training prior to assignment to a territory. Send complete resume to Personnel Department.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
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East Chicago, Indiana

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Excellent opportunity with midwest manufacturer of mechanical power transmission components. Desire man experienced in sales engineering work with OEM and industrial distributor sales. Salary and expenses—Age 27–35 preferred but not necessarily a requirement. Send photo and complete resume.

Address CA-6247, % "Mechanical Engineering."

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Spencer seeks a man with enthusiasm, drive, and a desire for future progress in plastics sales or technical assignment. Plastics processing experience and/or sales experience desirable but not necessary. Location would be east coast or mid-west. Excellent opportunity for future advancement exists in a rapidly expanding organization where annual sales have reached $45 million. Please send resume of your experience to:

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We are seeking engineers for our Baton Rouge, Louisiana plant. Salaries commensurate with training and experience, excellent benefit plans.

MATERIALS HANDLING ENGINEER: graduate mechanical or industrial engineering, 25–35, with minimum of 5 years' experience in industrial bulk materials and container handling methods in chemical industry.

TECHNICAL INSPECTOR: graduate mechanical engineer, 25–35, with minimum of 5 years' experience in inspection of chemical plant or refinery equipment. Pressure vessel design or fabrication will be considered in part as experience credit.

Interested applicants are invited to submit resumes of training and experience to:

R. S. Asbury
Ethyl Corporation
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to develop and design tomorrow's methods and machines.

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Mechanical Engineers

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Our Research Division has an attractive position involving a variety of challenging assignments relating to our extensive theoretical and applied research program. This program is made up entirely of civilian projects.

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To keep ahead in the field of power, we are actively engaged in nuclear power generation projects. Engineers with reactor experience are urged to investigate opportunities with our rapidly developing Nuclear Power Division.

For further details, write to:

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The GENERAL *Idea*

ON ENGINEERING CAREERS

GENERAL SYSTEM

What?—digital computer techniques used in telephony?

Ferrite cores and other promising memory devices are being adapted for use in electronic telephone switching systems at General Telephone Laboratories. (Actual size [6])

The engineer with a background in digital computer work is often surprised to find that, (A) the telephone industry offers a real opportunity for his specialized knowledge, and that (B) in telephony he is apt to face an interesting new challenge in terms of circuitry and high-speed switching operations.

At General Telephone Laboratories, we are making extensive use of computer technology to develop the telephone systems of tomorrow . . . as well as to solve the everyday problems of circuitry in existing systems.

We are, for instance, engaged in extensive research and development work on all-electronic, transistorized switching systems. An important phase of these projects involves memory devices. Existing techniques, such as ferrite cores, will require quite a lot of adaptation to meet the demands for speed imposed by electronic telephone switching. We are exploring every known technique of memory storage, including ferrite cores and photo memory devices, for both temporary and semi-permanent applications.

Electronic circuit design and packaging is another area where computer experience finds a valuable outlet at General Tel Labs. In logical circuit design as applied to telephony, the engineer can apply his creative abilities to the fullest extent.

If the foregoing gives you some idea that telephony, far from being static, is one of the truly dynamic industries from an engineering standpoint, that's the way we intended it. At General Telephone Laboratories, our work ranges far beyond the telephone as such. Providing R&D support for Automatic Electric Company and the other affiliated manufacturing units of the General Telephone System, we work in the entire field of Communications and Controls.

Notes on growth . . .

Right about the time you read this, the General Telephone System will add its 3 millionth telephone, an increase of nearly 100% since 1950! Of interest to the engineer looking to his future is the fact that the General System's growth is rooted in one of the most stable businesses in our economy. This is a fact well worth considering, if your present job has more alleged glamour than stability.

You're invited . . .

General Telephone Laboratories is expanding to keep pace with the healthy growth of the General Telephone System—not only its operating companies but its far-flung manufacturing operations as well. If you are qualified for important R&D assignments in electronics, electrical, electro-mechanical or mechanical engineering, we have a career opening that provides the hard-to-find combination of challenge and security. We'll be happy to give you the details about your specific opportunities. Write to Mr. Robert Wopat, President, General Telephone Laboratories, Northlake, Illinois.

GENERAL TELEPHONE LABORATORIES
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A member of the General Telephone System—One of America's great communications systems

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Write to Technical Personnel Department

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* The asterisk indicates that firm has product catalog in the 1958 Mechanical Catalog.

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Burgess-Manning Co.
Byers, A. M. Co.

Cannon Electric Co.
*Cash, A. W., Co.
Chapman Valve Mfg. Co.
*Chicago Bridge & Iron Co.
Clearprint Paper Co.
Cleveland Worm & Gear Co.
Cone-Drive Gears Div.,
Michigan Tool Co.
*Consolidated Chimney Co.
Crane Co.
Curtis Mfg. Co.

Davis Engineering Corp.
DeZurik Corp.
Donley Products
Dravo Corp.
*Dresser Industries (Inc.)
Drop Forging Association

Eagle Signal Corp.
Edward Valves (Inc.)
*Elastic Stop Nut Corp. of America
Ellison Draft Gage Co.

Farval Corp.
*Flexitallic Gasket Co.
Formica Co.
*Foster Wheeler Corp.
Fulton Sylphon Div.,
Robertshaw-Fulton Controls Co.

*Gouids Pumps (Inc.)
*Grinnell Co.

Hamilton Mfg. Co.
Hankison Corp.
*Homestead Valve Mfg. Co.
Horspool & Romine Mfg. Co.
Houdaille Industries (Inc.)
Buffalo Hydraulics Div.
Manzel Div.

Imperial Tracing Cloth
Irving Subway Grating Co.

*James, D. O., Gear Mfg. Co.

*Ladish Co.
Lake Shore (Inc.)
Lake Shore Engrg. Div.
Lefax Publishers
Lincoln Electric Co.
*Loewy-Hydropress Div., B-L-H
Lunkenheimer Co.

Maryland Shipbuilding & Drydock Co.
*Mercoid Corp.
Merriman Bros. (Inc.)
Lubrite Div.
Michigan Tool Co.
Miehle-Dexter Supercharger
Div. Christensen Machine Co.
Miller Valve Co.

National Supply Co.
Niagara Blower Co.
Nice Ball Bearing Co.
Non-Linear Systems (Inc.)
North American Aviation (Inc.)
*Northern Blower Co.
Nuclear Measurements Corp.
Nugent, Wm. W. & Co.

*Oilgear Co.

*Pacific Pumps (Inc.)
Div. Dresser Industries (Inc.)
Panoramic Radio Products (Inc.)
Pantex Mfg. Co.
Parker White Metal Co.
*Pennsylvania Pump & Compressor Co.
Perfection Gear Co.
American Stock Gear Div.
*Porter, H. K., Co.
W-S Fittings Div.
*Posey Iron Works (Inc.)
Post, Frederick, Co.

Raybestos-Manhattan (Inc.)
Packing Div.
Read Standard Corp.
Reinhold Publishing Corp.
Reliance Electric & Engineering Co.
Reliance Gauge Column Co.
Research-Cottrell (Inc.)
Reznor Mfg. Co.
Ric-Wil (Inc.)
Ronald Press Co.
Ross Heat Exchanger Div.,
American-Standard
Rust-Oleum Corp.
Ruthman Machinery Co.

Sanborn Co.
Sheffield Corp.
Shenango Furnace Co.
Stephens-Adamson Mfg. Co.
*Struthers Wells Corp.
Div. Titusville Iron Works Co.
Sturtevant, P. A., Co.
Synchro-Start Products (Inc.)
*Syntron Co.

Technical Charts (Inc.)
*Titusville Iron Works Co.
Div. Struthers Wells Corp.
*Tube Turns
*Tube Turns Plastics (Inc.)

*Union Iron Works
U. S. Hoffman Machinery Corp.

Van Nostrand, D., Co.

Watson, H. S., Co.
Western Gear Corp.
*Wheeler, C. H., Mfg. Co.
*Wickes Boiler Co.
Div. Wickes Corp.
Wiedeke, Gustav, Co.
Wiley, John & Sons

*Zallea Brothers

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assures improved pipe welds

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To meet modern requirements for better pipe welds where high temperature, high pressure, and corrosive conditions exist, Arcos now offers the Consumable Weld Insert. Used for making the root pass, the EB Insert assures sound crevice free welds with smooth uniform inside contours. Saves money and time in fabrication . . . minimizes turbulence, and promotes trouble free service. Write for details. ARCOS CORPORATION, 1500 S. 50th St., Philadelphia 43, Pa.

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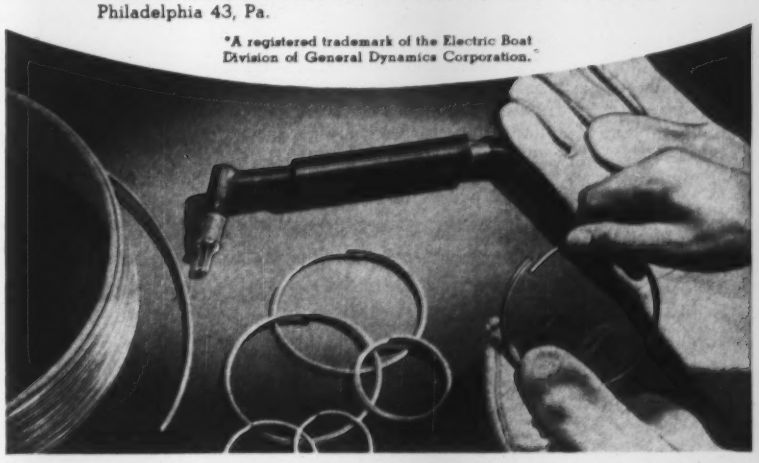


Handles for the gold-plated (left) and standard "Heavy" (center) Gillette safety razors are made from Anaconda leaded commercial bronze special-shape seamless tube, .4525" O.D., .371" I.D. "Regular" model (right) is of commercial bronze .395" O.D., .324" I.D.

Gillette shaves costs with Anaconda special-shape tubes

The problem: The Gillette Safety Razor Company, Boston, Mass., formerly used drawn shells for the handles of its famous line of razors. Press-fit assembly of components called for very close tolerances and suppliers of the drawn shell had difficulty in controlling the dimensions to the accuracy required. Rejects and production delays were becoming a costly problem to Gillette, and there was also excessive waste of material in trimming the shells after the knurling, grooving and rolling operations.

The solution: American Brass Company representatives suggested the use of special-shape (fluted) tubes to meet the tolerances required—in alloys suitable for the machining operations. Gillette tried the idea and now uses Anaconda special-shape tubes for handles of three models.

Long lengths of the tube are fed into high-speed, multiple-spindle machines which automatically convert the tube to razor handles ready for the plating room. Production is greatly increased, rejects and waste material are reduced to a minimum, and the uniformity of the handles simplifies assembly. Most important of all to the Gillette Safety Razor Company is the improved quality of the finished product.

Save Material and Production Costs: Special-shape seamless tubes—of copper, copper alloys or aluminum—in standard lengths, or cut to specified lengths, can save several steps in arriving at a finished product. The American Brass Company's French Small Tube Division are specialists in producing small tubes (up to ¾" O.D.) of special design and, in addition to maintaining a wide range of stock dies, are ready to cooperate fully in the development of new shapes to meet specific requirements.

For Action: Contact our nearest District Sales Office or send a sample, drawing or description, estimated quantity, kind of metal required and other pertinent data to: The American Brass Company, French Small Tube Division, Waterbury 20, Conn.

5772

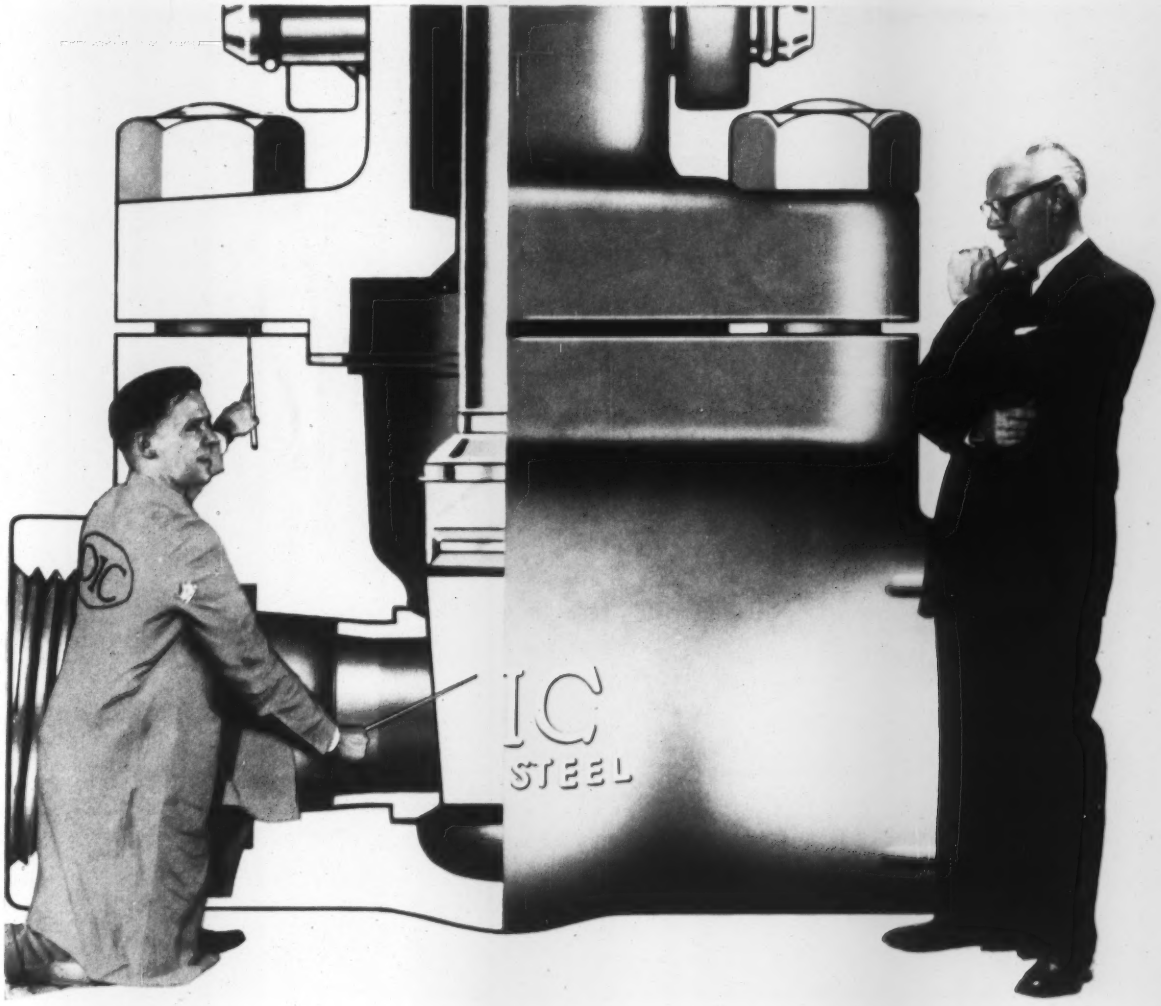
ANACONDA®

SPECIAL-SHAPE TUBES

Made by The American Brass Company

SPECIAL-SHAPE TUBES IN LONG LENGTHS OR CUT UP—
IN COPPER, BRASS, BRONZE, NICKEL SILVER, ALUMINUM

...and you can see here....and here, sir, how we've killed maintenance problems on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges *duracased* to a rugged *1000 Brinell hardness*.

The square and *bolted* body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

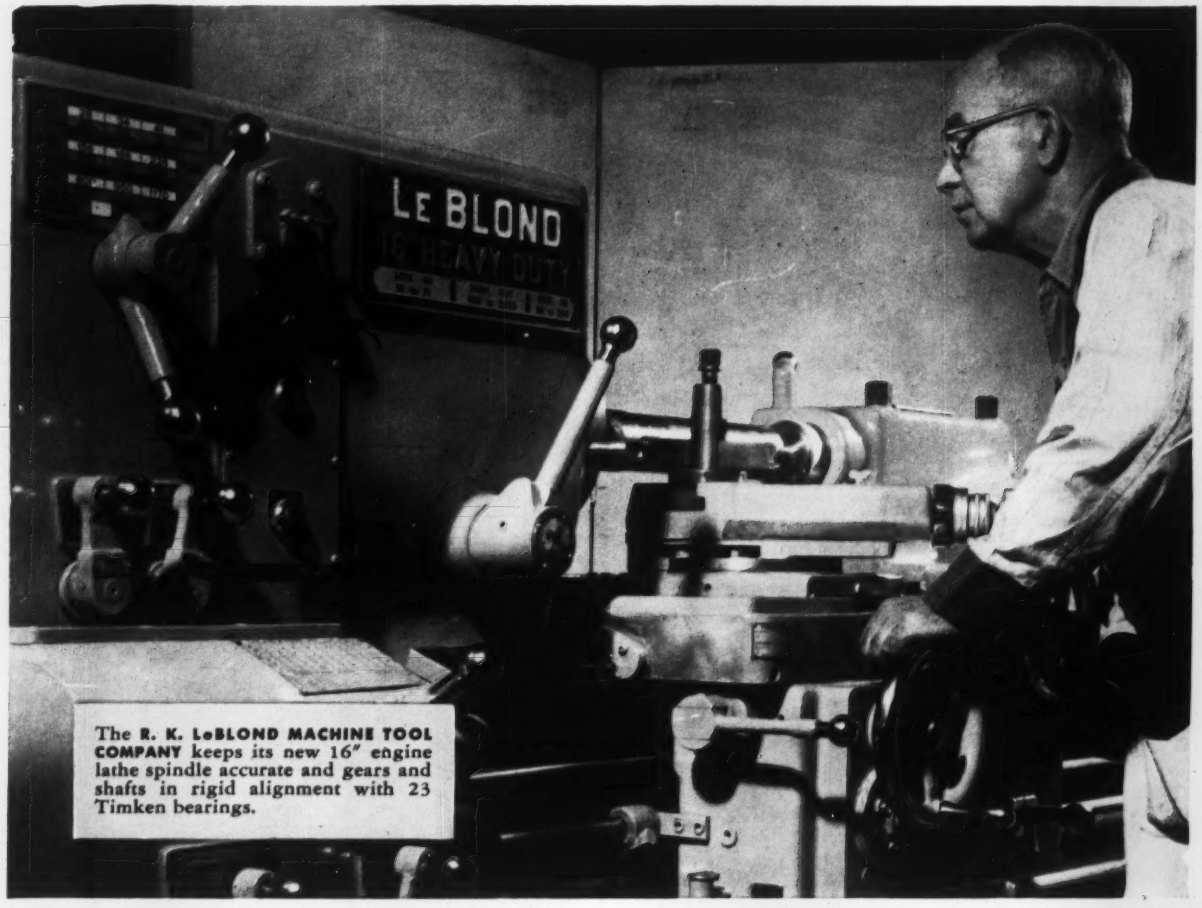
And you get the fastest joint make-up you've ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how body-bonnet flanges are out of the wrench's way. No time lost here!

These new 600-lb. OIC forged steel valves are available with either *high-flow* ports (1300 line), or *standard-flow* ports (1100 line). Call your OIC Distributor, or write for specification literature.

The Ohio Injector Company • Wadsworth, Ohio

OIC VALVES

BRONZE, IRON, FORGED AND CAST STEEL, LUBRICATED PLUG VALVES



The **R. K. LeBLOND MACHINE TOOL COMPANY** keeps its new 16″ engine lathe spindle accurate and gears and shafts in rigid alignment with 23 Timken bearings.

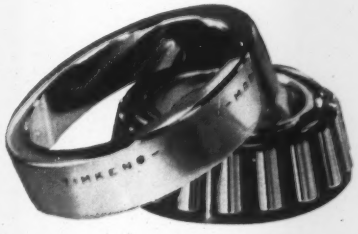
16 or 2000 RPM—23 TIMKEN® bearings take varying loads on LeBLOND 16″ engine lathe

EFFICIENT carbide turning was the goal when The R. K. LeBlond Machine Tool Company built their 16″ engine lathe. That meant high precision at low as well as high speeds; high rigidity for smooth hogging or fine finishing. To take the heavy cutting loads and still maintain precision they mounted the spindle on two single-row cone adjusted Timken® tapered roller bearings at the front and one two-row cone adjusted Timken bearing at the center position. Twenty more Timken bearings keep gears and shafts aligned in the 27-speed headstock and in the tailstock. To compensate for differential expansion between starting temperature and operating temperature and at varying operating speeds, the new Timken high-speed mounting was used to contain the center spindle bearing. The LeBlond Company says the new 16″ engine lathe is the most rugged yet precise machine they have ever built.

Wherever wheels and shafts turn, Timken bearings are the standard of excellence. They virtually eliminate friction. Their full line contact insures extra load carrying capacity. They're engineered to give true rolling motion; and they're precision manufactured to live up to their design. We even make our own steel to insure the highest quality.

When you buy or build machines, make sure you specify Timken tapered roller bearings. They're your No. 1 bearing value. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO".

This symbol on a product means its bearings are the best.



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